COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

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SPEARFISH CREEK TUNNEL OF THE HOMESTAKE MINING COMPANY

To secure electric current for operating its mills, mine pumps, etc., The Homestake Mining Company, Lead, S. D., has developed a water power of 6000 k.w. capacity from the iall of Spearfish Creek securing a working nead of 665 ft. An interesting account of the entire installation is contributed to Mining and Engineering World by Mr. Richard Blackstone, Chief Engineer and Assistant Superintendent of the Company. Our readers will be chiefly interested in the construction of a long water tunnel which was an important detail of the work, and the following description we abstract from the article above referred to.

From the side of one bank, just above the dam, the water enters the intake of the tunnel which extends in practically a straight line 23,800 ft. (4½ miles) in the direction of the power house. The finished tunnel is 6½ ft. wide with vertical sides 5 ft. high and a semicircular roof with a radius of 3 ft. 3 in. It was driven through solid rock in sections, crosscuts being made through the hill from suitable points along the route. The sides and floor of the tunnel are lined with concrete, and the arched roof is similarly lined for three-fifths of the length.

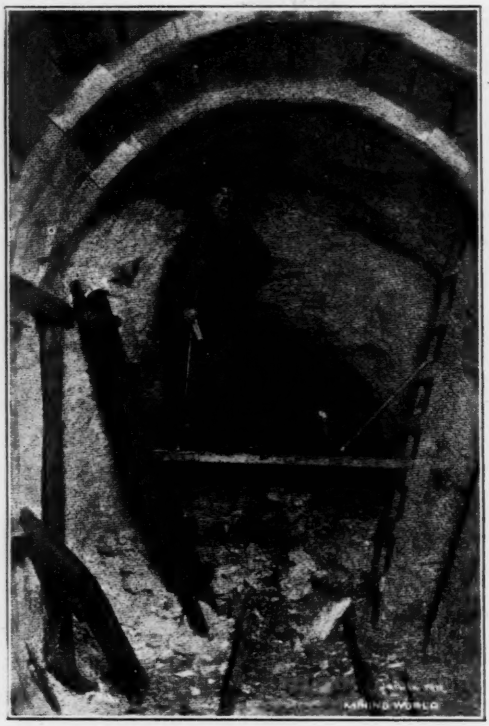
It was found that the tunnel could extend from the intake to the forebay on a very direct line, and that the side canyons or ravines cut into the line of tunnel at intervals, which naturally divided the work into sections of convenient lengths for rapid excavation, as follows: Section one, 1695 ft.; section two, 4152 ft.; section three, 4082 ft.; section four, 4154 ft.; section five, 1284 ft.; section six, 3762 ft.; section seven, 2074 ft.; section eight, 2389 ft., or a total of 23,862 ft. Crosscuts were driven in, on the grade level, at each of the stations to the intersection of the tunnel center line, each intersection being an angle point in the tunnel—except at station five. In locating these angle points it was planned to have the tunnel in solid rock, rather than in loose rock or earth, to save timbering and avoid "running" ground, regarless of the length of crosscuts.

ELECTRIC POWER ENTIRELY.

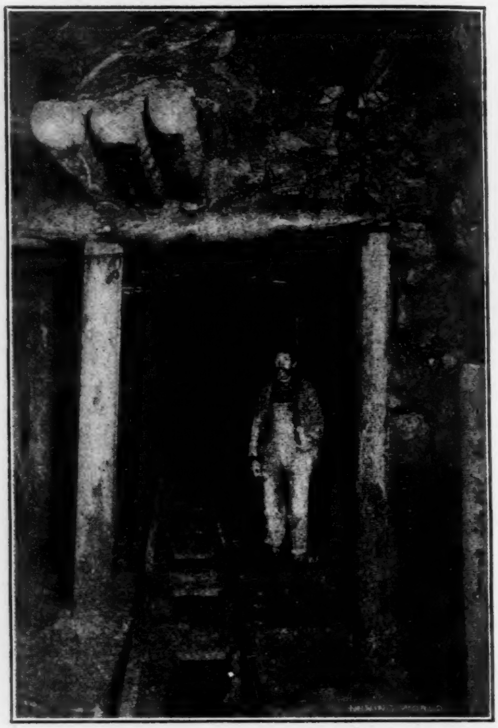
The company was the owner of a hydroelectric power plant near the northerly end of the tunnel. It had been built for lighting Spearfish town and was equipped with one 100-kw., 2300-volt, alternating-current Westinghouse generator. This electric output was used not to exceed 8 hours out of 24. Another 100-kw. Westinghouse generator of the same voltage was installed, so both could be run in multiple.

A transmission line was built up the valley to the intake, with branches to each station. Transformers were erected as near the tunnel entrance as convenient, stepping down current to 220 volts, with leads to the Temple-Ingersoll electric air drills at the working faces of the tunnels, and to the Sirocco blowers, which furnished the ventilation to the miners working in the tunnels. It was also used to pump water from Spearfish creek to Stations Nos. 2, 3, 7 and 8. The Nos. 7 and 8 pumps worked against a head of 600 ft., delivering 10 gals. per minute. Gravity water was available at Stations Nos. 4, 5 and 6. Fourteen Temple-Ingersoll electric air drills were used, allowing extra ones for repairs. Drill sharpening shops were built at the tunnel levels and close to crosscut entrances.

All tunnel work was done in three 8-hour



DRESSING DOWN FOR TIMBERS.



TIMBERING FOR BUILDING SIDE WALLS.

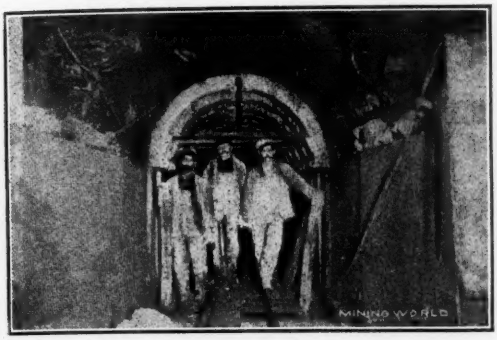
shifts. The crosscuts were driven to the center line surveyed for the tunnel, and turned right and left, making two working stations for each crosscut. The tunnel, as above noted, is divided into eight sections, three of which were over 4000 ft., as stated. The drilling was done in one face, with a single drill, and mucking in the other, alternating with each shift. Each shift started drilling and blasted one round of holes, while their muckers were working at the other face. The rough section of tunnel excavation was about 8 ft. wide by 9 ft. high. From 12 to 14 5-ft. holes were drilled for each round. The center-cut method was used, fired by hand; cut holes, side holes and back holes, with lifters last. Steel sheets, 120 by 30 by 3/8-in., two at each face, were used as floors to shovel from. The regular Homestake mine cars were used for mucking, and were hand trammed to dump on all sections of the tunnel; 200 gross tons of steel rails, 20-lbs. per yard, were used, with 4 by 6-in. sawed pine ties for supporting the track.

Two or three large pockets of water were tapped. One in tunnel No. 4 broke out suddenly and in great volume, pushing the miners out of the tunnel. This soon drained down, but disclosed a great open gash in the limestone rocks, filled with loose rock, boulders and mud; and it proved a trying piece of work before the run of debris was bulkheaded off. In tunnel No. 2 several strong streams of water were cut and proved to be permanent in their flow, slowing down the progress in this tunnel which was the last to hole through.

MAXIMUM POWER CONSUMPTION.

It may be of interest to note that the maximum metered power used in driving this tunnel seldom exceeded 30-hp. The power used was metered, and a daily report made of the current put on to the tunnel transmission line.

The ventilating was accomplished by means of Sirocco fans having a capacity of 500-cu. ft. per minute, through 2000 ft. of 9¼-in. galvanized iron pipe made on the ground from sheets delivered there. These were put together with slip joints and sealed with muslin asphalted to the pipe. The pipe was kept within 200 ft. of the face of the drift extension, wood boxes being used at the discharge ends

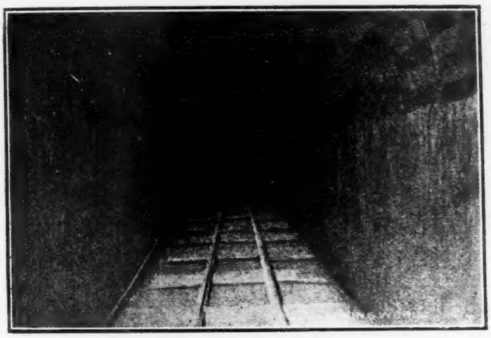


ROOF FORMS FOR CONCRETING.

as protection against flying rocks from the blasting and to carry air near to the face of the tunnel.

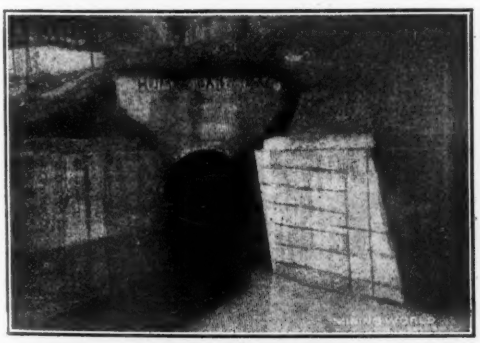
TUNNEL PROGRESS.

The progress made in the tunnel is shown in the appended table. The work was begun



TUNNEL LINING FINISHED.

in May, 1909, and finished in October, 1910. For driving the tunnel we employed miners, a great many of whom were from the Homestake mine, and the shift bosses were all of



DISCHARGE FROM TUNNEL.

our own selection. This work was in progress at the time of the trouble in Lead, when the change from union labor was made, and we passed through it without any suspension of operations. In connection with this work, the building of construction camps and roads formed a considerable item of cost, including roads to the crosscuts. It amounted to about 20 per cent. of the whole. To our advantage, however, was the proximity of the Burlington railroad for supplies, enabling us to unload material at any one of the crosscut stations.

TABLE SHOWING TUNNEL PROGRESS.

Date.	Ft. per week	Powder per ft., lbs.	Power (HP.)
Dec. 19, 1909	404	17.0	21.9
Dec. 26, 1909	400	17.0	21.9
Jan. 2, 1910	420	15.0	23.2
Jan. 9, 1910	424	17.0	23.2
Jan. 16, 1910	431	15.0	22.9
Jan. 23, 1910	455	15.0	26.3
Jan. 30, 1910	504	14.0	24.9
Feb. 6, 1910	562	15.0	12.9
Feb. 13, 1910	550	15.0	25.5
Feb. 20, 1910	539	16.0	26.1
Feb. 27, 1910	516	17.0	25.6
March 6, 1910	551	15.0	26.6
March 13, 1910	576	15.0	30.0
March 20, 1910	503	17.0	28.6
March 27, 1910	496	17.0	29.4
April 3, 1910	514	17.0	31.4
April 10, 1910	494	17.0	32.
April 17, 1910	516	16.0	32
April 24, 1910	524	14.0	30.7
May 8, 1910	546	16.0	30.7
May 15, 1910	608	15.0	33.7
May 22, 1910	553	15.0	32.3
May 29, 1910	459	17.0	30.8
June 5, 1910	517	17.0	32.9
June 12, 1910	518	13.0	27.2
June 19, 1910	527	9.0	28.1
June 26, 1910	424	14.0	25.7

	Began.	Finished.	Feet.	Daily av. Feet.
No. 1	July 9, 1909	June 22, 1910	1,965	5.65
No. 2	July 9, 1909	Oct. 8, 1910	4,152	9.10
No. 3	July 23, 1909	Aug. 12, 1910	4,082	10.60
No. 4	July 10, 1909	July 29, 1910	4,154	10.82
No. 5	Aug. 22, 1909	Jan. 5, 1910	1,284	9.45
No. 6	Sept. 10, 1909	Aug. 5, 1910	3,762	11.40
No. 7	Sept. 30, 1909	June 23, 1910	2,074	7.77
No. 8	Dec. 8, 1909	Sept. 4, 1910	2,389	9.00

Water from a subterranean stream bursting through the lining flooded the Simplon tunnel in Switzerland to a depth of 2 ft. on July 7. Workmen were immediately rushed to the tunnel to repair the tracks and pump out the water, and it was hoped that traffic could be re-established in a few days. A train was derailed in the middle of the tunnel, but no one was hurt. During the interruption on the Simplon line traffic was diverted to the St. Gothard tunnel.

MEASURING COMPRESSED AIR FOR COST DISTRIBUTION

BY B. B. HOOD

Compressed air is used around mines for purposes other than rock drilling, and in order to apportion the costs fairly a measurement of the various quantities is usually desirable Various meters are obtainable that will do this, but they are expensive and not always at hand. At one of the mines in northern Michigan, it was necessary to ascertain approximate figures of air consumption as a basis for cost distribution.

One steam-driven, 5000-cu. ft. Nordberg compressor supplied the air for the mine. This was practically new and in good order. The pressure of 75 to 80 lb. was kept on the mains for 120 hr. per week. A week was taken for the period during which measurements were to be made. The air delivered by the compressor was consumed as follows: (1) Pipe-line losses; (2) Saturday afternoon blowoff; (3) blacksmith shop; (4) two rock houses; (5) rock drills and blowing powder gases; (6) underground pumps.

To account for the large line losses at the time of this test, it may be well to describe the lines. The surface air lines consisted of nearly 6000 ft. of 8-in. pipe buried in the ground. A large part of it was galvanized spiral-riveted pipe. This failed as an air pipe in two ways. The ends of each length of pipe was fitted with pressed-steel flanges. The faces of these flanges were not true and the surfaces were too small to hold a gasket after the latter had become saturated with oil; consequently they blew out and had to be often repaired. The continual expansion and contraction of the line, due to its having to carry hot air for some hours and then cool off, loosened the riveting. Some pieces of pipe would have small leaks throughout their entire length. These failures were most apparent in the 500 ft. nearest the compressor. The underground air lines were practically tight. As they were exposed to inspection, this was verified and no account of their loss was made.

The compressor had a minimum capacity of 845 cu. ft. of free air per min. Repeated attempts to make it run slower than this were not successful, as the flywheel would not carry it over centers. This was more than the pipe-line loss, so one afternoon between 5.30 and 6.45, when the compressor was usually shut down, a blowoff valve was adjusted to allow the 845 cu.ft. per min. at 78-lb. gage pressure to escape. The air mains were shut off from the compressor during this adjustment, then they were charged with air at 78 lb. and the increased number of revolutions of the compressor noted over a period of 30 min. From this it was computed that the surface-line loss was 205 cu. ft. of free air per min. Figuring that the pressure was maintained on the lines for 120 hr. per week, this would amount to 1,480,000 cu. ft. of free air, which was the line loss during that period of time. The underground lines were shut off during this test because all of the machine valves were open to blow powder smoke.

No air was used underground from Saturday noon until Monday morning, but it was required for other purposes until 11 p. m. Saturday evenings. At times the demand would fall below the minimum capacity of the compressor, and in order to keep the engine running it was necessary to blow off some of its product. A small receiver was made of pipe fittings. This was furnished with an orifice 1½ in. in diameter in a $^3/_{16}$-in. plate, a thermometer, and a pressure gage. The instrument was used as a blowoff one Saturday afternoon. Compressed air was admitted into the receiver through a valve and was controlled to meet the requirements of the compressor. The pressure and temperature of the air in the receiver were taken at intervals. From these readings it was computed that the total free air blown off during the afternoon and evening was 338,000 cubic feet.

The air used by the blacksmith shop was measured by means of pitot tubes placed in a tube 20 in. long with a true 1-in. bore. The pitot tubes were made of $^1/_{16}$-in. outside diameter copper tubing. They were soldered into a ⅜-in. to ½-in. pipe bushing, so that when the latter was screwed into a tapped hole in the side of the 20-in. tube, they extended into the tube ¼ in. One of them faced the air current while the other was square with it. They were connected to a glass U-tube made of two steam-gage glasses connected at their lower ends with rubber hose. Water or mercury was used to determine the velocity head of the current of air. The 20-in. tube was fitted with a thermometer and a pressure gage some distance from the pitot tubes and behind them so that eddy currents were kept from the

tubes. The following formula was used to compute the air flowing through the tube:

$$Q = 135 \sqrt{\frac{H\ (P + 14.7)}{t + 460}}$$

Where

Q = Cubic feet of free air per min. at 60° F. and 28.5 in. barometer flowing in the 1-in. tube;

H = Height of water in inches representing velocity head. (When mercury was used, the readings were multiplied by 13.6, the specific gravity of the mercury.)

P = Gage reading;

t = The temperature of the compressed air (° F.).

The instrument was set in the air line some little distance from the blacksmith shop, so as to have between it and the shop some receiver capacity in the shape of pipe line. This took off some of the sharp peaks in flow caused by the drill sharpener and the hammer. It was found that the drill sharpener, furnace and forge working 36 hr. per week used 550 cu. ft. of free air per min., or 1,188,000 cu. ft. per week; the other forges in 18 hr., at 160 cu. ft.; the hammer in 6 hr., at 720 cu. ft. of free air per min., used 259,200 cu. ft., giving a total for the shop per week of 1,620,000 cu. ft.

Air was supplied to two rock houses to operate chute gates and drop hammers. On Saturday, from noon until 11 p. m., compressed air was used by the rock houses and for 2¾ hr. by the blacksmith shop. On the Saturday afternoon of the week of the test, the following was obtained: Total air compressed from noon till 11 p. m., 670,000 cu. ft.; blowoff, 338,000 cu. ft.; line loss, 118,000 cu. ft.; blacksmith shop, 27,000 cu. ft., leaving for the amount consumed by the rock houses in 8 hr. actual operation, 187,000 cu. ft. In the 72 hr. per week of rock-house operation, about 1,683,000 cu. ft. of air was, therefore, required.

Most of the rock drills were of the 3⅛-in. piston type. Arrangements were made to suspend pumping for one shift during the week, and make it up during the next shift. During that time there were 22½ drill shifts worked. The following results were obtained: Total air compressed during the shift, 1,439,000 cu. ft.; line loss, 120,000 cu. ft.; blacksmith shop, 270,000 cu. ft.; rock houses, 140,000 cu. ft.; difference consumed by drills, 909,000 cu. ft. This was used both for actual drilling and for blowing the powder smoke. The mine had good natural ventilation, so that the compressor was shut down soon after drilling ceased. If the drill machines operated on an average of 4½ hr. actual running time during the shift, the figures reduce to 150 cu. ft. per machine per min., which is a figure often used when estimating compressor capacity required. During the week in question, there were 111¼ machine shifts worked, which required, on the basis of the figures, 4,490,000 cu. ft. of free air.

Pumping water with air is expensive. One of the mine pumps had been previously tested. An Ingersoll-Sergeant 12 and 14¼x14-in. compressor furnished air for a No. 10 Cameron mine pump, 14 and 8x13in. No other uses were made of the air and the air line in this case was tight. Indicator cards were taken from both the air and steam cylinders of the compressor. The valve adjustments were good and the pistons tight. The total pumping head of the pump, including suction and pipe friction, was 103.1 ft. The water pumped was measured by a 4-in. orifice in a tank at the surface. The overall efficiency from steam indicated horsepower to useful work done on the water was only 6.81%. In the present case, the amount of air used by the mine pumps during the week was determined by difference, as is shown in the following table, which also gives the complete air distribution for the week.

It is true that succeeding weeks might not have had the same distribution percentage, but to obtain an accurate distribution for the cost sheet of each month would take an expensive equipment.—*Eng. and Min. Journal.*

	Cu.Ft. Free Air	Per Cent. of Total Compressed	Per Cent. Total Delivered by Mains
Total air compressed....	19,200,000	100.0	....
Airline losses	1,480,000	7.7	....
Blowoff	338,000	1.8	....
Blacksmith shop........	1,620,000	8.4	9.3
Rock houses............	1,683,000	8.8	9.7
Rock-drilling machines.	4,490,000	23.4	25.8
Underground pumps....	9,589,000	49.9	55.2

A MINE AT THE PANAMA-PACIFIC EXPOSITION

The U. S. Bureau of Mines has undertaken to construct, in co-operation with the mining industry and the manufacturers of mining machinery, a mine beneath the floor of the Palace of Mines and Metallurgy at the Panama-Pacific Exposition.

The financial and operative success of the mine is assured through exhibits promised, whereby typical metal and coal mining operations will be reproduced by full-size working places, in which mining machinery will be installed and operated. The walls of the mine will be covered with either ore or coal typical of the mine illustrated. Among others, the Copper Queen Co. of Arizona, Bunker Hill & Sullivan Co. of Idaho, Homestake Mining Co. of South Dakota, Goldfield Con. Mines Co. of Nevada, Jones & Laughlin Co. of Michigan, Lehigh Coal & Navigation Co. of the anthracite field of Pennsylvania, Pocahontas Fuel Co. of West Virginia, Consolidated Coal Co. of Kentucky, and Pacific Coast Coal Co. of Washington, have each agreed to reproduce one of their working places or stopes, and to contribute the sum necessary to the installation and operation. Tentative promises of similar action have been received from the Rock Island Coal Co., Peabody Coal Co., and Pittsburg Coal Co.

Mining machinery and appliances have been promised in abundance and in full variety from the various manufacturers.

The entrance to the mine will be through the Bureau of Mines space, and visitors will be attracted to it by being given portable mine lamps, and by being lowered in a cage, while a panoramic effect of the strata lining a shaft will pass by them so rapidly as to produce the illusion of descending to a considerable depth. In case of crowds, these may enter by a slope. Exit will be by a slope into the radium booths of the Bureau of Mines, where actual radium emanations will be shown.

There will be a motion picture room which visitors will pass in going from mine to mine. In it will be shown such great open workings as are not illustrated by the underground mines, such as those of the Utah Copper Co. and those of the Nevada Con. Co. at Ely, the iron diggings at Hibbing, Minn., hydraulic gold mining, and the quarrying of building stone.

Twice each day there will be an "explosion" or fire in some portion of the mine announced by telephone to the superintendent's office in the Bureau of Mines space on the surface, and rescue men wearing breathing apparatus will enter the mine and bring out "victims" who will be given first-aid treatment in the surface emergency hospital.

In the Bureau of Mines space on the floor of the main building there will be, in addition to the radium booths, exhibits of carnotite, pitchblende and other radium ores, their alloys and concentrates, an emergency mine hospital and smoke room for rescue training, exhibits of fuel efficiency, smoke abatement, explosives, mine welfare work, etc.

The prime purpose will be that of educating the investing public, stockholders, members of legislatures and the uninformed antagonists of the industry relative to the importance of the mining industry, its extent, variety and the cost of operation.

PNEUMATIC AUGERS IN AUSTRALIAN MINES

In our issue for March of the present year, at page 7166, a brief note called attention to the use of the pneumatic auger for removing timbers in Central Mine, Broken Hill, N. S. W. Mr. James Hebbard, manager of the above mine, kindly sends us some additional particulars as follows:

The principal work for which the auger is used here is in the repair of crushed timbered drives and crosscuts. In this operation large quantities of old 10 by 10 in. Oregon pine legs and caps have to be removed, together with the decking, in restricted spaces where the use of axe or saw would be tedious at best or almost impossible. The drills are also very useful in various other minor jobs, such as for boring holes for hanging bolts in shaft sets, or for bolts for hand rails at shafts and winzes.

The tool used is the No. 11 Imperial Piston Drill, and the auger bit found most suitable is 1½ in. diameter. This is for our Oregon pine; a smaller bit would doubtless be preferable for hard wood. The advantages of the pneumatic auger over axe or saw for cutting through heavy timbers in the confined limits of a narrow drive will be readily appreciated.

Coal tar is now used as a fuel in steel furnaces at Gary, Ind. It is first heated to liquid form, then sprayed into the furnaces, mixed with blasts of air under pressure.

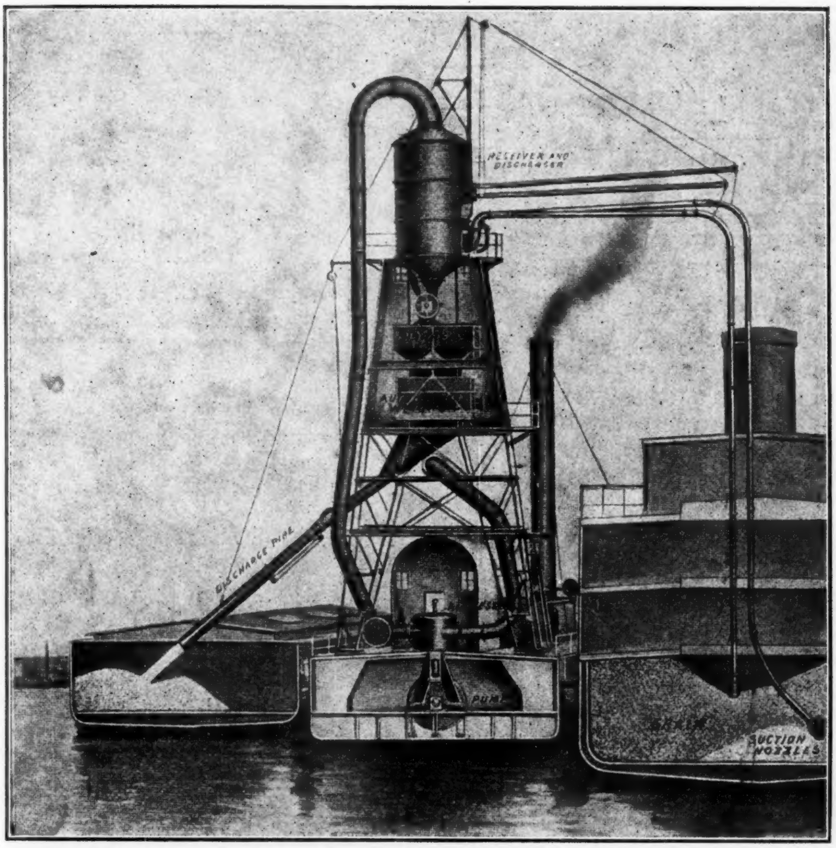


FIG. 1.

PNEUMATIC GRAIN ELEVATORS*

BY JACQUES BOYER.

It has become a well-established custom, in handling grain in large quantities, to use bucket-chain elevators for vertical transfer, and worm conveyors or traveling belts for horizontal motion. By such means as this, a large cargo can be loaded or unloaded in a very short time and with but small expenditure of power, even if the vessel is anchored at some distance from the store of grain.

But apparatus of the kind mentioned presents one disadvantage: If any change is to be made in the path of travel of the material handled, it becomes necessary to introduce more or less complicated intermediate apparatus, and the natural simplicity of the installation is therewith forfeited. In fact, the handling of grain cargoes in port presents technical difficulties which vary according to the size of the ships, the location of the cargo, etc. Thus, on first starting to unload, the grain reaches right up to the hatchway, say 15 to 20 feet above water-level, so that the bottom of the elevator must be set at that elevation. Later, as the cargo dwindles down, the elevator must dig deeper and deeper, ultimately, some 20 feet below the water-level. Finally, when the cargo is completely unloaded, it becomes necessary to lift the end of the elevator over the deck, say 40 feet above water-level. In other words, the end of the elevator must be capable of an extreme travel over some 60 feet up and down, or more in the case of large modern transatlantic steamers.

In view of these difficulties, the older methods, using bucket chains, etc., have been largely abandoned in favor of pneumatic grain conveyors. These consume a little more power

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*Scientific American Supplement. Translated from *La Nature*.

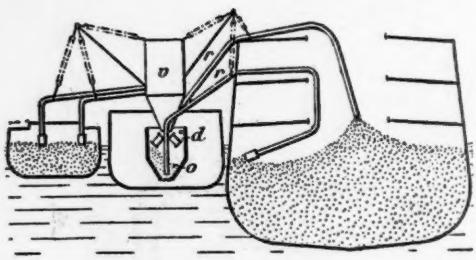


FIG. 2.

than the older types, but offer great advantages in point of ease of handling, economy of space, improvement of the merchandise (since dust is automatically separated from the grain), etc.

One of the most recent types of pneumatic grain elevators is constructed by a German firm of Brunswick, on a principle diagrammatically indicated in Fig. 2. In this drawing, *v* represents a vacuum chamber, kept exhausted by means of vertical or horizontal piston pumps. Air is thus sucked in through the pipes *r* and draws with it the grain from the hold of the steamer. The grain falls upon a double weigher *d*. This is shown in detail in Fig. 3, and consists of two drums R R_1 which are pivoted on a horizontal axle *T*, and can thus be brought, the one or the other, in alignment with the opening of the hopper *V*. As soon as one of these drums is filled, it tips over and discharges, while the other drum steps into charging position.

The following table shows the power consumed by the elevator here described:

Quantity of Grain Handled per Hour. (Tons).	Horse-power Consumed.
20	42
40	75
75	135
100	175
150	250

An important installation has been constructed on this principle at Brake on the Weser (Germany). This comprises four conveyers with a total capacity of 800,000 pounds per hour. The first three of these are placed on floats, the fourth is attached to a grain storehouse. The power required for the elevator and accessories is derived from five rotary motors having an aggregate capacity of 1,000 horse-power.

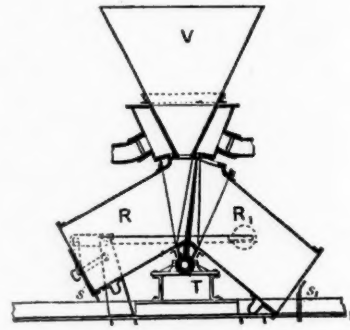


FIG. 3.

AN ENGLISH APPRECIATION OF THE CATSKILL AQUEDUCT

The following is taken from a report of an address by Mr. W. T. Taylor at a London meeting of the Society of Engineers.

As an exploit of purely technical engineering, the creation of the Catskill aqueduct and the Ashokan reservoir surpasses the Panama Canal. Apart from the unique methods of handling materials on the latter, it may be roughly stated that the problem meant merely digging out earth and rock on a large scale and dredging channels; to build the aqueduct meant piercing mountains and undermining rivers, traversing deep, broad valleys, and tunnelling through the bowels of the city of New York from end to end. The tunnel alone is 34 miles long—the longest in the world—and lies 200 ft. to 750 ft. below the city streets. In a few months the first link will be completed. One hundred and twenty-seven miles away the water will begin its three days' journey to the southernmost end of the metropolis from Ashokan reservoir in the Catskill Mountains, and running through a giant aqueduct, pass down the westerly side of the Hudson River, cross under through a huge, deep siphon at Storm King, thence to the Croton reservoir system, and through the present distribution pipes to New York. The aqueduct, the longest and deepest in the world, has an easy flow of 500,000,000 gallons a day. The principal quantities of work and materials involved in the Catskill system, as planned for the first development from the Ashokan reservoir to Hill View, are approximately 4,430,000 cubic yards of masonry, 17,170,000 cubic yards of excavation, 18,425,000 cubic yards of embankment, 21,250 tons of steel pipe and other metals, and 5,450,000 barrels of Portland cement.

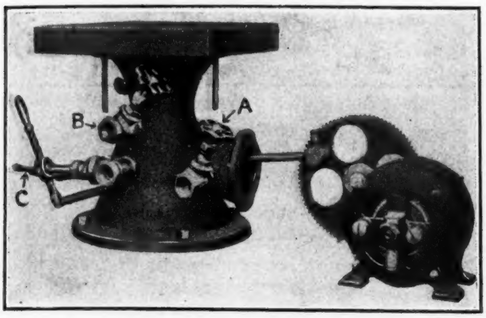


FIG. I.

A PNEUMATIC JAR-RAMMING MACHINE

The illustrations on this page, reproduced from Foundry, show an interesting pneumatic jar-ramming machine which seems to have taken an idea, and adapted it with some variations, from the electric air rock drill. The machine is entirely self contained, being actuated by an electric air motor which is an integral part of the apparatus. Normally, when work is going on the motor runs constantly, driving the piston of the horizontal compressing or pulsating cylinder. Atmospheric air is admitted to this cylinder through the intake valve A, and is compressed by the advancing piston so that the pressure raises the vertical plunger and table and when the exhaust port B is uncovered the air escapes and the table drops, giving the required jar to the flask of sand on the table. The jarring operation is controlled by opening and closing valve C, which in Fig. 1 is shown open.

By substituting a through-way valve for valve C sufficient air can be compressed while the machine is not jolting to be used for the vibrator, the blow-gun, or to raise the table for pattern drawing. In Fig. 1 the gear case has been removed. The exhaust is connected to this gear case. When in position the air, containing more or less oil serving to lubricate the running parts and also providing a slight pressure sufficient to keep out sand and dust. As the case is not air-tight the air escapes without any other provision. The machine is built by William T. Krause, 3623 North Ashland avenue, Chicago.

There has been recently such a demand for copper abroad that 300 tons of the metal were shipped on the first eastern trip of the Vaterland.

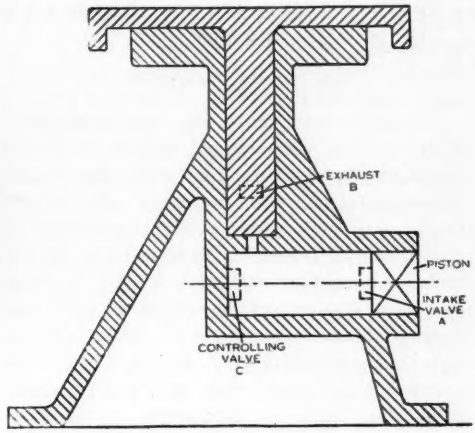


FIG. 2.

FORM FOR MISSED-HOLE REPORTS

An ingenious method for reducing the probability of missed-hole accidents was adopted in sinking the Monarch-Pittsburg shaft, at Tonopah. The idea is not entirely new, having been used in the Cœur d'Alenes previously. A blank form was placed in a conspicuous place of the change house, and in the rectangle a plan of the holes in the shaft bottom was made. The shift coming off after blasting, marked rings around the dots representing the holes which it was suspected had missed, and each member of the shift signed below. The shift coming on also signed at the bottom as an indication that each member had examined the diagram. Two purposes were served by this device. (1) The new shift was forced to receive information of the possibly dangerous holes; (2) the liability of the company to damage suits was decreased, since the signatures of the men would show that they were informed of the danger.

Experiments have been carried out at Toulon with a new type of diving bell invented by an Italian engineer. The bell is without internal air pressure and is fitted with hammers, tongs, and other tools, fastened to the outside, but capable of manipulation from within the bell. The inventor had a narrow escape from death when testing his bell. He had descended to a considerable depth, when the bell became entangled in some rocks, and half an hour elapsed before he could be released from his dangerous situation.

A SURFACE CONDENSER FOR STEAM ROCK DRILLS

BY FRANK RICHARDS.

A special drill scow for submarine work, with at least one unique feature, has been doing excellent service in channel and harbor improvement work at Bermuda. As is well known, all fresh water available anywhere in the Bermuda Islands is rain water stored in tanks and sold at various prices up to $4.50 per ton. This makes the use of steam in any considerable volume, without recovery of the water, almost prohibitive. A special drill scow adapted to the conditions, operating two large submarine drills, a steam winch and a steam pump, is equipped with a simple surface condensing arrangement so efficient that only 1½ tons of water per week are required for renewal or replacement. Besides the saving of the water, which is most important, there is a considerable saving of coal, there is no exhaust steam and no noise around the work, and there is always pure feed water. Practically no cylinder oil is used for internal lubrication and oil makes no trouble in the boiler.

Before the building of the scow, the drills were located one on each side of the dredger "King George," which necessitated the complete cessation of dredging whenever drilling was necessary. In other words, an expensive dredger had to be temporarily turned into a drill scow. As a considerable amount of rock has been encountered that could not possibly be dredged without blasting, about four days' blasting were required to give two days' dredging, the arrangement resulting in an output of 800 to 1000 tons per week. Since using the drill scow, and alternating the work of drill scow and dredger at different portions of the channel, the average per week has been raised to over 4000 tons.

The scow is 41 feet long, 25 feet wide and 5 feet deep, draws about 15 in. of water, and after six months' continuous service is as "tight as a bottle." The framing is 4x8 in. and the planking and deck is 2½x12 in. To protect from worming the bottom is covered with three coats of tar and arsenic.

The scow is moved from place to place by kedge and warp from the niggerhead of the steam winch, and the moorings are handled from the same, the drum of the winch being used for hoisting. There are four spuds, two 8x8 in. and two 9x9 in., 34 ft. long and all steel shod. These are located in spruce spud guides 10 ft. long, securely fastened to each corner of the scow. Each spud is hoisted from the niggerhead of the winch through lead blocks and a sheave on top of an 8x2-in. upright. It is held down by a wire down-haul pendant and fall secured by an eye bolt in the deck and led to the niggerhead to give it tension.

The boiler is a vertical tubular, 4 ft. in diameter, 6 ft. 6 in. high, with 140 tubes, 3 ft. 4 in. long, the usual steam pressure being 60 lb., gage. The boiler easily supplies the two drills, the air pump and a duplex pump for forcing water into the holes when drilling. This latter pump was found extremely beneficial in removing the material in the soft strata which would fall down and choke the drills.

The air pump used is a 4x6x8-in. Davidson, and the condenser consists of 160 running feet of 2-in. galvanized iron pipe bolted under the bottom of the scow. Although the scow when working is practically stationary, and the temperature of the sea water in summer is about 75 deg. Fahr. at the surface, a vacuum of 22 in. is easily maintained.

A corrugated iron roof extends fore and aft over the drill track and the steam and exhaust pipes are secured to this. The connections to the drill cylinder and feed engine are by flexible steam hose. The fresh water tank, or hot well, is built of wood in one corner of the scow, and the powder house is located on the deck directly over it. The scow was built by day labor under the direction of the engineer in charge. The cost without the drills was about $4250.

The drills, 5 in. piston, H. A. Ingersoll-Sergeant, are mounted on drill frames, lock-jointed and movable fore and aft on a steel-faced track with eyes and hook bolts for securing the frames every 5 ft. The largest drill steel used is 35 ft. and the shortest 10 ft. and about 4 lb. of blasting gelatine is used per hole.

CHARACTER OF ROCK.

The rock that has to be handled is a conglomerate of varying hardness, from an unstratified hard and close grained material (limestone) to a stratified material composed of the above with an almost sandy stratum between, the latter being probably the most difficult to deal with. Owing to the fact that

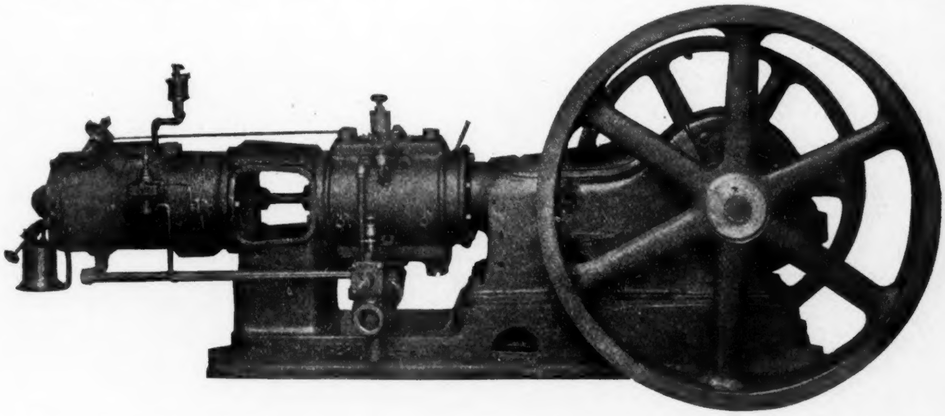
there is no regularity as to this hard rock it is found to be the cheaper and more satisfactory method to locate the "humps" and charge the holes with a diver. Under ordinary conditions about eighteen holes, 7 to 8 ft. deep, have been drilled per day with one drill.

The scow has sometimes been used in the outer portion of the channel in a moderate ocean swell and has given very fair results, even under these extreme conditions. A second dredger, the "Queen Mary," has recently been added to the equipment and extensive channel improvement is on the program.

For all of the above information I am indebted to W. B. Smith, engineer in charge, St. Georges, Bermuda.—*Engineering Record.*

8 inches stroke, and at a normal speed of 325 r. p. m. will compress and deliver 66 cu. ft. of free air per minute at 100 lb. gage pressure or 73 cu. ft. at 80 lb., full allowance being made for clearance and re-expansion.

At the rear of the air cylinder a distance-piece is attached for carrying the oil engine cylinder, the air piston rod being continued into the latter. This piece serves as a standard for the end of the machine and gives a long sub-base bearing. The oil engine cylinder is completely isolated from the air cylinder, so that the air is not heated when running, and with this construction the machine may be easily taken apart and reassembled without the possibility of getting anything out of line.



AN OIL ENGINE DRIVEN AIR COMPRESSOR

It may now be said that there is no mode of power generation and application which is not available for the driving of some type of air compressor built by the Ingersoll-Rand Company. The machine here illustrated, which may be said to complete the series of compressors so far as the driving is concerned, as it is designed to be driven not by gasolene, which is now becoming so costly, but by the cheaper kerosene, fuel oil or distillate, may claim the unique distinction of being operated at a lower cost per volume of air compressed than any other type of compressor in existence for which the power is artificially developed.

The air compressing portion of this machine is of the latest standard Ingersoll-Rand type designated as NE or NF, the details of which need not here be enumerated. The air cylinder as here shown is 7 inches diameter and

The general operating design is of the "hot bulb" type, a close relation of the Diesel engine without the complication of the highly compressed air injection. A torch is provided for heating the ignition bulb preparatory to starting the engine, but after the compressor is under way the heating is self maintained. The fuel is automatically injected into the combustion chamber by means of a small pump operated by the main shaft. It enters in the form of a finely atomized spray and is immediately ignited by the hot bulb. The stroke of the fuel pump is regulated by a centrifugal governor in the flywheel, and this determines the amount of fuel injected into the cylinder, making it proportional to the load. This method of regulation is also supplemented by a regulating device on the intake of the air cylinder.

The method of operating this unit is accompanied by none of the losses common to many

two-cycle gasoline engines, in which part of the incoming charge follows the exhaust gases through the outlet ports. This is due to the fact that the fuel is not vaporized by an outside agency and introduced with the air used for "scavenging;" but is injected directly into the cylinder at the end of the compression stroke. This means that pure air is used during the scavenging period of the stroke, with the result that the inlet and outlet ports can be arranged in such a way that more thorough scavenging is effected without any loss of fuel. The absence of a carbureter with its needle valves, springs and delicate adjustments, which require constant attention to suit varying atmospheric conditions is also a material advantage.

Another feature of the engine is the provision of means for inducting a small quantity of water from the cylinder jacket into the combustion chamber. This water performs the function of regulating the temperature in the cylinder, thereby preventing an undue rise in the temperature of the piston and cylinder walls, which would be liable to result in a disassociation of the fuel oil. This practice reduces the maximum pressure in the cylinder but slightly increases the mean effective pressure, making a smooth running and highly economical engine. The amount of water injected is regulated according to the load on the compressor.

The compressor as here shown occupies a floor space of 8 feet 10 inches by 2 feet 5 inches and weighs 3000 pounds. Under average operating conditions, and with the normal air output the fuel consumed is about 2.2 gallons of kerosene per hour.

Frederick Bates and Francis P. Phelps have recently published an elaborate treatise on "The Influence of Atmospheric Conditions in the Testing of Sugars." The researches in question cover a wide range of experiments. The writers assert that the question of atmospheric conditions exerting an appreciable effect in testing sugar, has been but vaguely recognized for some years. The magnitude of this influence had, however, never been determined, and they express astonishment that this possible source of error has been ignored so long when one remembers how painstaking scientists have worked to reduce the testing of sugar to an exact science.

PNEUMATIC CAISSON EXPERIENCE IN SHAFT SINKING

In an interesting article by Mr. P. B. McDonald, in a recent issue of Mining and Scientific Press, he tells of the difficulties encountered in sinking shafts which have to be driven through quicksand, the locality being among the iron mines of Michigan and Minnesota. In dealing with both the sand and the water great ingenuity is required, and the limit of mechanical resource is often apparently reached.

The pneumatic caisson is only available within certain limits, the principal one being the physical ability of the men to work in the pressures required, although the same pressures also act to prevent the caisson from sinking as required.

The Foundation Company, the article continues, does not pump water, but holds it back by compressed air. Thus, when the mining company begins sinking in rock, it may have trouble in the first few feet due to water, the iron ore being essentially an oxidized formation, and water gets through it easily. The most troublesome part of the caisson work is generally at bedrock, because sand and pebbles may grade into hardpan and broken "ledge" so gradually that it may be thought bedrock has been struck when it is in reality not solid enough to warrant sealing. That is where the Foundation Company has trouble, and where the cost per foot may be several thousand dollars. The contractors sometimes lose money, as is believed to have been the case at the Morton shaft on the Mesabi where a huge sphere of concrete was rolled on the concrete drop-shaft to force it down. The caisson method is good for quicksand, but after penetrating a stratum of quicksand if a hardpan or stiff clay stratum is cut, the work goes very slowly. The "sand-hogs" can dig only intermittently and the shaft will refuse to drop from friction on its sides.

THE SAND HOG LIMIT.

The final pressure of air used at the Rogers shaft near Iron River was about 45 lb. per sq. in., which is not far from the limit of human endurance; each man worked two 40-minute shifts per day. Men are required to be in fair health, to have a good heart and digestion, and not to be drinking, to go into compressed air. It is not dangerous to an ordinary individual, although some people get in the air-lock and

when the air is turned on, decide that their constitution is not good and ask to be let out. The feeling is similar to that of being under water, and the voice sounds similar when talk is attempted. Due to the compressed air, candles several inches in diameter are necessary and even these burn very fast. Care should be taken not to allow the clothes to catch fire, as they will burn as though soaked in oil. In entering the caisson, several minutes are taken in the air-lock where the ordinary man holds his nose and blows into his ears by puffing his cheeks out; a foreman who goes in and out a half dozen times a day may just rub his hand across his nose a couple of times. Before going in, you can test the tubes between your ears and your mouth, by holding your nose and forcing air into your ears until each one "clicks," showing that the pressure is greater on the inside than on the outside of your ear drum. In the air-lock, as the compressed air gets into your system, the pressure on the inside of your ear-drums becomes the same as on the outside; it is only at first that it is greater on the outside. That most painful afflication the "bends" or its worse form "paralysis," which is due to coming through the air-lock too quickly on the way out, is said to be caused by bubbles of compressed air in the blood, which should have been given time to work out by the lungs and skin when in the air-lock. "Bends" in the arms is common, paralysis in the legs is worse, and when attacked in the muscles of the stomach one generally asks a bystander to kindly hit him on the head with an axe. Men with the "bends" are taken into a hospital-lock, a steel cylinder where compressed air can be turned on and then allowed to escape very slowly. The "sand hogs" drink warm coffee before going down.

The work of "sand hogs" at the bottom of a shaft is merely to pick and shovel; the dirt is hoisted out in a bucket. A dozen men will work a shift in broken bed-rock or in hard pan, and scarcely any difference can be seen; perhaps a couple of buckets will be sent up. Man's strength seems greatly diminished in the high air pressure. To keep the compressed air from escaping through the sand, a layer of clay is sometimes plastered around the bottom of the steel shoe. In spite of that, bubbles will frequently be seen coming out of the ground a hundred feet from the shaft. It usually keeps an air compressor or two busy supplying the pressure for the caisson, as the air leaks out through the sand and the walls of the caisson. The air is let out of the caisson when it is necessary to let the concrete shaft drop down the distance that has been excavated, perhaps a couple of feet; otherwise the air pressure holds the shaft up. Of course, the men are out when this is done, as the water floods in and has to be blown out.

SUPERHEATED COMPRESSED AIR TO CURE CANCER*

"Superheated Air as a Cure for Cancer" was the subject of an address delivered the other day by Dr. Bell in the Cancer research department of the Battersea Hospital. Up to 1903 Dr. Bell relied solely and not without success upon dietetic, hygienic and therapeutic treatment. He then employed superheated air as a local application, the treatment being supplementary to his former methods. Since the Cancer research department at Battersea has been in working order it has been possible, he says, to demonstrate how the important supplementary treatment of heating up the cancerous growth operates. "The knowledge thus gained," said Dr. Bell, "is bound to prove of supreme importance, as it has placed beyond doubt the fact that the cancer cell is unable to survive if retained at a temperature of 115 deg. to 120 deg. for a few minutes at a time, the application of the heated air being repeated at intervals under a pressure of from three to four atmospheres."

[The pressure here spoken of is understood to be the pressure behind the jet of air, to give the desired impinging and penetrating effect.—Ed. C. A. M.]

"The result apparently is that the vitality of the morbid cells is gradually destroyed, these cells subsequently becoming absorbed. It must, however, be clearly understood that this result can be assured only if the disease is dealt with in the early stages of its development. Three patients have been dismissed completely cured. Therefore if in the early days of the appearance of the disease patients will consent to present themselves for treatment we may, with confidence, look forward to the time when cancer will not be looked upon as an incurable malady."

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*London Correspondence, N. Y. Sun.

THE AIR LIFT FOR OIL WELLS

A valuable paper compiled by Ralph Arnold and V. R. Garfias and recently issued by the Bureau of Mines, (Technical Paper 70) treats of Methods of Oil Recovery in California, in which the Air Lift figures prominently. This portion of the paper is here reproduced in a somewhat condensed form.

The operation of the air lift depends on the buoyancy of aerated liquids. To obtain the desired results, air is pumped into the well through a small pipe to a convenient point below the surface of the liquid, where it is allowed to discharge into a larger pipe through which the aerated fluid rises above ground. It is important that air be admitted to the fluid in a finely divided state and in such a manner as to realize the full cross-sectional area of the discharge pipe for the passage of the liquid. The pumping of water by this method has been successfully accomplished for many years and most of the experience gained with the air lift has been obtained in pumping water. It is claimed that clean oil with a gravity of about 0.8641 (32° B.) can be lifted by air almost as readily as water, but that clean oil with a gravity of 0.9589 (16° B.) or heavier generally can not be recovered economically. However, a well in the Santa Maria district, producing oil of about 0.9859 (12° B.), is said to have operated successfully with air.

The successful operation of the air lift for pumping oil and water mixtures depends upon a number of factors, most important of which are: (1) The height of the column of fluid that the aerated mixture has to overcome or the height from air inlet to the surface of liquid in the well. This is known as submergence. (2) The total vertical distance from the point of admission of air to the point of discharge, the ratio between these two quantities representing the percentage of submergence. (3) The lift or distance from the surface of the liquid to the level of discharge. (4) The air pressure. (5) The pressure of gas in the well. (6) The gravity of the oil. (7) The percentage of water in the oil. (8) The quantity of sand in the oil. This method is used extensively in the Kern River field, where conditions are very favorable for its successful operation. The wells in this field are about 1,000 feet deep and produce oil with a gravity of 0.9722 (14° B.) and containing 80 to 85 per cent. of water, the submergence in most cases being between 250 and 400 feet, or about 33 per cent.

The quantity of air should be carefully regulated, the best results being obtained with the minimum volume of air necessary to cause the liquid to flow in a constant stream. Owing to the extra pressure needed to overcome the friction and inertia, the starting pressure is about double the working and calculated air pressure. The variations in the level of the liquid in the well are indicated by pressure gages on the compressor and air side of the valve that controls the air supply.

The gas that sometimes accompanies the oil helps the action of the air lift by diminishing the required air pressure, and in order to utilize all the available gas pressure it is customary to place a packer between the tubing and the casing, thus forcing the gas to flow through the discharge pipe. Wells of the same depth may require different pressures, and in order to obtain the best results a careful study of the special conditions will be desirable. In the Kern River field, wells about 1,200 feet deep are pumped with air under a pressure of about 180 pounds to the square inch.

In most fields where the use of compressed air proves most beneficial, the oil and water occur in somewhat well-defined layers—a lower indefinite layer of water, and upper one of nearly pure oil, and an intermediate layer consisting of a mixture of oil and water. In nearly all such fields the water surface stands at a well-defined plane; below water is obtained, above the percentage of pure oil increases with the distance above this plane. It is possible, therefore, providing the necessary submergence is available, to pump either water or oil, or within limits, any combination of the two, by regulating the location of the air inlet in relation to the water surface. If air is admitted to a stratum where water and oil are mixed the churning action caused by the air has a tendency to mix them more thoroughly and to form emulsions. This result is avoided sometimes by pumping the water and oil in the same well separately, using the air lift for the water and removing the oil by means of a plunger pump.

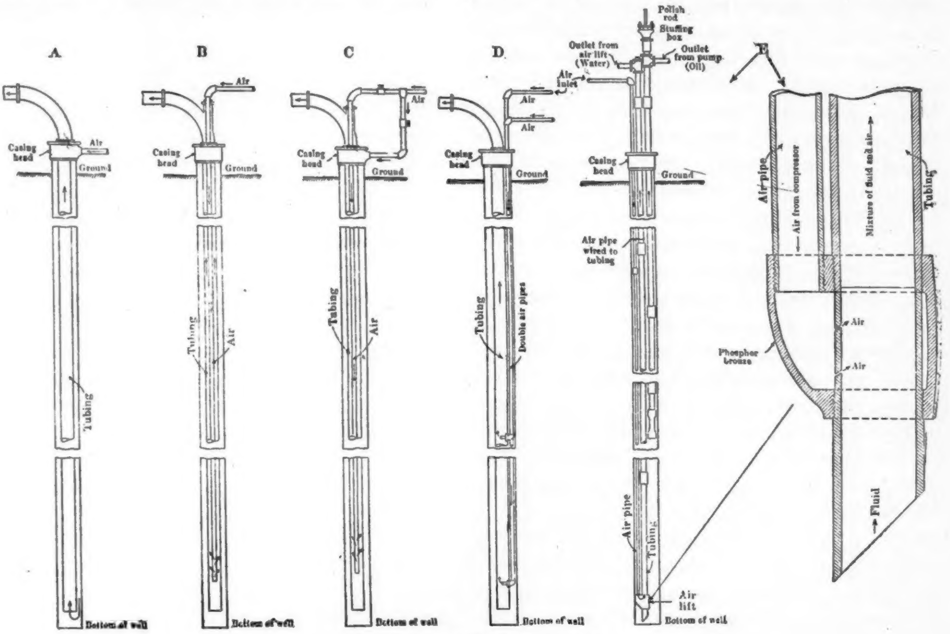
The conditions under which the use of an air-lift pump becomes advisable can be ascertained only after a careful and intelligent analysis of all factors affecting the operation of the property, and usually it will be found

economical to seek the advice of a competent mechanical engineer before incurring the necessary expense for development. The high initial cost renders the selection of compressed-air machinery of special importance, and the proper choice and disposal of air lines and well tubing, the regulation of air pressures, and the proper determination of the many factors involved in power-plant economics are each problems of such importance that their solution can be best determined by a technically trained man familiar with local conditions.

In general, it may be stated that air-lift pumping in the oil fields should be used as a last resort when the ordinary methods are no longer effective, and should be restricted to territory where considerable water accompanies the oil and there is ample submergence.

OPERATION.

The different arrangements of tubing for operating the air lift are shown in the cut. A shows a lift arrangement comprising an annular air tube, and B and C show an arrangement utilizing a central air tube. In the device shown at C the operation of the air lift is regulated, and to some extent improved, by admitting air under pressure in the annular space between the casing and the tubing. The arrangement of tubing represented by D, in which two separate air pipes are used, has not proved satisfactory. At E is shown a modified type of air-lift pump used successfully in the Kern River field. The air is admitted into the discharge pipe by means of the foot piece, as shown, and pumps the water; the oil above is removed by means of the plunger pump.



AIR LIFTS FOR OIL WELLS.

In most air-lift pumping the air is conveyed into the well through a 1-inch pipe, under a pressure sufficient to overcome the weight of the column of liquid representing the submergence, and is discharged into a 2½ or 3 inch tubing through a pump head or foot piece (C), which controls the distribution of the air. As the column of liquid becomes aerated and consequently lighter, the pressure can be correspondingly reduced. This method has given satisfactory results in some properties in the Kern River field. In at least one well in the Salt Lake field two plunger pumps are utilized in similar manner, one pumping almost clear water, while the other skims the oil higher up. In some wells it may even prove practical to use two separate air lifts, one for the water and the other for the overlying oil.

When large quantities of fluid are being removed from several wells within a small area, an underground migration of oil and water toward certain wells is established, and other nearby wells may be disprived of the oil and tap only the underlying water. If large quanti-

ties of water are pumped from these "water" wells by means of the air lift, the level of the water in the immediate vicinity will be somewhat lowered and the proportion of pure oil pumped in "oil" materially increased. The operation of such water wells, sometimes known as "key" wells, has therefore a marked influence on the oil productivity of the surrounding area.

Several formulas have been derived in an effort to develop a theory of the air lift pump on a mathematical analysis of the problem, but these apply only to conditions that prevail in pumping water, and do not necessarily apply when water constitutes only a fraction of the total volume of fluid pumped. Davis and Weidner state that "by varying the percentage of submergence, and therefore the lift, the length of pump remaining constant, the maximum efficiency (pumping water) is obtained at approximately 63 per cent. submergence for all rates of input or discharge."

The data collected in the oil fields apply only to local conditions, and results are necessarily dissimilar. In some instances the best results have been obtained with a submergence of about 60 per cent. In the Kern River field it has been found that the best results are obtained with a submergence of between 30 and 40 per cent., but owing to the varying nature of the oil-and-water mixtures, and to the many local modifications necessary in operation, it is doubtful whether even future investigations will warrant a single value for this ratio. In general, when mixtures of water and oil are being pumped pipes of about 2½ inches diameter, and somewhat greater submergence than the best value for water, give the most satisfactory results.

Hutchinson states that in the Kern River field a typical well, about 1,200 feet deep, is operating with an air pressure of 182½ pounds to the square inch at the surface and a 30 per cent. submergence.

QUANTITY OF AIR.

The consumption of air varies with change of any of the conditions affecting the efficiency, such as submergence, height of lift, quality of the oil, quantity of water and sand in suspension, and volume and pressure of accompanying gas. Representative tests have shown a consumption of eleven or twelve volumes of free air to one of fluid pumped, and for less efficient operation the proportion of air to fluid may be fifteen to one, or more.

The transmission and application of energy by the use of compressed air always involves a low over-all efficiency. Between input to the compressor and net work in terms of oil lifted, the efficiency will average only about 30 per cent.

In the Kern River field, with a 35 per cent. submergence, which has proved on the whole most satisfactory, the consumption per well per minute has averaged about 140 cubic feet of free air, compressed to a pressure of 152 pounds per square inch. After estimating the theoretical required volume of air, an adequate margin of safety should be allowed in calculating the quantity of air needed in actual practice.

ADVANTAGES.

The principal advantages of the air-lift system are its great capacity, low operating cost, and low cost of upkeep at the wells from absence of moving parts, thus making it especially suited for handling oil-and-water mixtures carrying a considerable quantity of sand, which would rapidly wear valves and pump barrels.

In properties where the oil produced contains considerable water the exhaust steam from the compressor plants can be carried through pipe coils and utilized for heating the fluid to a temperature at which the water and oil will separate. This method of heating oil is inexpensive, lessens the work on the engine condensers, and saves the consumption of fuel oil needed to realize the same purpose. A temperature of 150° F. can be thus maintained in the heating plants, giving excellent results in dehydration. Certain emulsions containing 50 per cent. of water before treatment have been reduced to a point showing not over 2 per cent.

The air lift generally works in a satisfactory manner when not over 20 per cent. of sand accompanies the oil. Thompson notes that a fluid mixture containing as much as 50 per cent. of sand has been removed by the air lift. The presence of clay in suspension generally occasions much more serious trouble.

DISADVANTAGES.

Some oil operators maintain that although the use of compressed air will, beyond reasonable question, increase the production in comparatively shallow wells for a limited time, nevertheless, after a certain amount has been recovered, the oil seems to recede. This claim is seemingly substantiated by the fact that at times neighboring wells increase in production,

while those operated with air decline. This condition, however, may be due to a number of factors other than the action of the air.

Another factor that limits the use of the air lift is the depth of submergence required. The extraction of mixed water and oil in large quantities from small areas lowers the water level, thus increasing the height of lift and the degree of submergence necessary to maintain a fixed percentage. The lowering of the pipe to meet these conditions must ultimately bring it to the bottom of the well, thus leaving a residue of liquid which can be removed only by an increasingly uneconomical use of the apparatus.

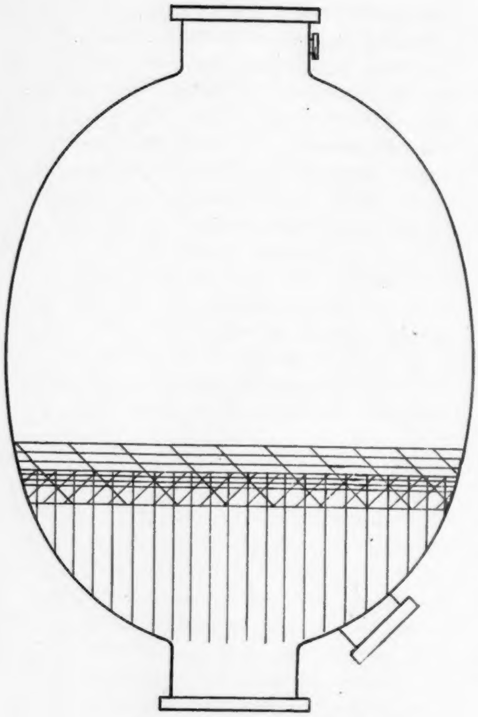
In wells in which there is not enough fluid to allow continuous operation it becomes necessary to apply the air intermittently. Such operation, however, may cause sand to run in and give serious trouble. In such cases it is generally best to use the plunger pump, say every 24 or 48 hours, and recover only the accumulated oil, an operation that is often spoken of as "skimming." The air lift is not generally satisfactory for pumping heavy, viscous oil, as the air and oil do not mix readily, and the aid escapes carrying little or no oil with it. The violent agitation of the fluid. caused by aeration, leads at times to the formation of emulsions, which are separated with difficulty. As a rule the greater part of the water and oil separates if the mixture be allowed to settle after heating, but some emulsions require either an electric treatment or partial refining in order to separate their constituents. Because of the general characteristics of air-pressure machinery and appliances, the high initial cost and the sums invested in existing installations, the use of air-lift pumping is to be considered only where the wells are numerous, not widely scattered, and not of excessive depth, and when the fluid in the wells rises high enough to provide the necessary submergence and carries a large admixture of water, but not excessive proportions of sand and clay.

USE OF COMPRESSED AIR IN ENGINES.

A special plan developed to meet peculiar conditions is now in practice in the Salt Lake field. On one property there are 52 wells, averaging 1,200 feet deep and producing oil with a gravity of 0.9655 (15° B.) and large quantities of gas. Considerable sand accompanies the oil, necessitating frequent cleaning of the wells. The boiler water contains a large percentage of incrustating solids, necessitating the cleaning of the boilers on an average of every eight days. As there is no market for the gas, the cost of fuel is a small item in the total cost of operation. The property was first operated entirely with steam, but its use became impracticable owing to the poor quality of the boiler water and the large amount of condensation that took place in the long steam lines, the wells being scattered over 500 acres of territory. It was found, however, that steam installation could be replaced advantageously by using compressed air in place of steam for the operation of the engines. This plan was adopted and has been in successful operation for about two years. The air is compressed to a pressure of 38 pounds per square inch in three 1600-foot per minute, steam-driven, condensing, cross-compound, single-stage, duplex air compressors, and is reheated at the wells to a temperature of about 200° F. by means of a small burner using natural gas as fuel. As steam was necessary to operate the engines for drilling or cleaning the wells, and for heating oil for its separation from water, all the steam equipment was retained. Much of the boiler trouble has been eliminated by using condensed water from the compressors, it being estimated that 24 wells are now pumped with the same boiler that formerly handled 10.

TUNNEL ACCIDENTS

Bulletin 57, issued by the U. S. Bureau of Mines, tells us that tunnel accidents in sixteen important works have averaged 4.7 deaths annually and nearly three times as many serious and thirteen times as many slight injuries per thousand men employed. While most of the accidents were caused by ore or rock falling from the roof or walls of the tunnel, many of them were the result of ignorance or gross carelessness and could have been avoided. Many of them occurred from the improper use of explosives. To reduce the number of accidents it was recommended that roof blasts should be made with as small charges of explosives as practicable; that men be detailed to remove loose pieces of roof immediately after the blast; that each man carefully inspect the roof under which he works; and that any doubtful piece of rock be tested by impact, and if vibrations can be detected by touch or through a stick, the rock be immediately removed.



WOOD PULP COOKER.

A NOVEL USE FOR THE SAND RAMMER

The pneumatic sand rammer is now employed, especially in England and Germany, for packing the wooden chips and allied materials in the large steam cookers in celluloid factories. These cookers or digesters, see sketch, are normally egg shaped and of great size, say from 20 to 80 ft. high, with other dimensions in proportion. The loose chips are first dumped in to a depth of 10 or 12 ft., and then a man is lowered through the central opening in a suspended chair and he keeps going over the mass with a sand rammer until it is packed down to a height of 3 ft. or so. Then another large quantity is dumped in which is rammed in the same way, and so on until the vessel is entirely filled.

The cover is then secured and steam is admitted and continued under a certain pressure for a certain period. The small side opening at the top permits a sufficient discharge of air to secure an effective circulation of the steam. Some judgment is required in the use of the rammer as it is possible to pack the material so tightly as to render it impermeable to the steam. The sand rammer in this service is not only a great time and labor saver, but also does the work in a much more satisfactory manner.

VACUUM DEVICE FOR FILLING A LARGE BALING TANK

At the Daggafontein Gold Mining Company's property on the extreme southeastern Witwatersrand sinking is proceeding as rapidly as circumstances will permit, but operations have of late been much hampered by the presence of hard dyke rock and the influx of large quantities of water. An ingenious vacuum baling tank is now being installed to bale out water from the shaft. For the following particulars of this device, we are indebted to Mr. J. M. Martyn, the manager of the Daggafontein G. M. Co. An air-pump for creating a vacuum is being placed 300 feet above the bottom of the shaft. This air-pump is to be driven by a Pelton wheel, and the head of water is 500 feet, the displacement of air in the pipes being equal in area to the displacement of air in the tank. Four-inch diameter pipes are carried down to within 40 feet of the shaft bottom; at the end of 4-inch pipes a 40 feet length of flexible hose is attached. A four-inch diameter pipe is carried up to within an inch of the tank top, the lower end of the pipe coming through the side of the tank, which carries a vacuum brake connection coupling. A leather-faced valve operates on a seat connected to a valve spindle and fitted with a ball-joint at the top of the valve, the spindle working through guides The seat, on which the valve operates is raised five inches above the bottom of the tank, with turned face to prevent leakage, the seat being bolted to tank bottom and the top-heads of bolts counter-sunk. An eight-inch diameter valve is connected to the side of the tank and is operated at the top of the tank, the spindle of the valve passing through a stuffing gland; this valve is fixed in the tank to provide for emptying the tank at the side if required. An air-tap, one-inch diameter, is fixed on the top of the tank to admit air at atmospheric pressure the moment the tank is being emptied. Fixed on the side of the tank is a gauge glass to indicate when the tank is full, the gauge glass is protected by ribs of iron. A man-door is fixed on the centre of the tank to admit of repairs to valves, etc. A perforated plate with wire mesh cover is fixed over the valve orifice at the bottom of the tank to prevent small stones from getting in between valve face and seat. The end of the flexible hose leading

down from the vacuum pump is fitted with a corresponding half vacuum brake coupling with a stop-cock immediately above. When the tank arrives at the bottom of shaft it is guided into the water sump, the eight-inch diameter spill valve and one-inch air tap at top of tank being closed. The vacuum brake coupling at the end of flexible hose and the corresponding half on the tank are instantly attached and the stop-cock opened. The air in the tank being immediately exhausted, the tank fills in 15 seconds through the twelve-inch valve at the bottom of the tank. The stop-cock is shut when the gauge glass indicates that the tank is full, and the vacuum couplings are detached when the tank is free to ascend the shaft.—*South African Mining Journal.*

SHEEP CREEK TUNNEL

We present here a brief, but interesting discussion of the machines and methods used to drive the Sheep Creek tunnel of the Alaska Gastineau near Juneau, Alaska. The information comes originally from the mining company itself.

From Dec. 1, 1912, to Feb. 1, 1914, a period of 14 months, the tunnel was driven 7670 ft., an average speed of 548 ft. per month. The equipment and routine during this period were not changed.

The tunnel or adit is 8½x10½ ft. in section, driven along the general strike of the formation, a short distance on the foot-wall side of the contact of the ore zone with the country rock. The character of the ground varied a good deal. The first 2000 ft. approximately was in a tight, closely laminated slate, the remainder was through greenstone and metagabbro. The ground was all hard and tough; the best footage was made in greenstone. The monthly record was made in November, 1913, when 661 ft. was driven.

Three crews of men were employed. Each crew worked 6 hours and rested 12 hours. This resulted in a complete cycle of operations every three days. Considered by days, the average working time per day for each crew was eight hours; this was the time at the face, as the incoming shift always relieved the outgoing at the working place. Each crew consisted of a shift boss, eight machinemen, six muckers, one carman, one motorman and one brakeman; three men were also employed on the compressed-air and ventilating pipes, the ditch and the floor.

Drilling was carried on with E-44, 3¼-in. Ingersoll-Rand machines on two horizontal bars, 4½ in. by 9 ft. The compressed air was obtained at 105 lb. from an Ingersoll-Rand 22- and 13x16-in. machine of the Imperial type driven by a General Electric 200-hp. motor. Half of the compressed-air line was of 7-in. casing and the other half of standard pipe.

Ventilation was furnished by four high-speed exhaust fans driven by General Electric form K, 20-hp. induction motors running at a speed of 1740 r.p.m. These were spaced about 3000 ft. in the tunnel and were operated as exhaust machine, delivering the exhausted air into a ventilating pipe, 15 in. in diameter, of 18-gage galvanized iron.

The cars used were 1½-ton side dumpers with roller bearings; they were handled with a 6-ton Jeffrey storage-battery locomotive. The track was of 24-in. gage, laid with 50-lb. rails. There were no switches installed, but at certain intervals iron slick-sheets were laid alongside the track and the cars were transferred to them by the carman using a crowbar. A false track, 25 ft. long was placed over the rail ends when needed to keep the cars up to the muck pile.

A 1-in. water line was kept well up to the face and water was used to wash down the muck pile at once after blasting, in order to kill the gas. The drills were sharpened with a No. 5 Ingersoll-Rand sharpener; about 600 pieces of steel per day were used.—*Eng. and Min. Journal.*

A LIFE-LINE GUN

Among the various equipment of the New York fire department is a life-line gun. From this gun a line fitted with a plug or harpoon, much the same as that used by the life savers of the sea and in the whaler's cannon, is fired. Because of the great accuracy and dependability required in this branch of the life savers' work, an especially equipped .44 cal. Remington is used to fire the life line. At times, it is necessary to shoot this line into a window several stories from the ground or over the roofs of buildings. A very light carrier line is used, but to this line is attached a heavier line capable of carrying enormous weights. The heavy line is easily pulled up and made fast, when the well trained fireman is able to slide down with the rescued person.

THE DEEP MINES OF THE RAND

The Village Deep Mine at the end of the year had been opened up to a depth of nearly 200 feet below the plane of the 21st level. At the present time a maximum working depth of about 4,500 feet has been reached in this property, the depth of the Turf Mines shaft being 4,200 feet, and the work carried out below the bottom of this shaft representing in vertical depth a further 300 feet.

SOME ULTRA-DEEP MINES.

The Village Deep is thus the deepest mine at work on the Central Witwatersrand, and now that operations in the Jupiter and Cinderella Consolidated have been suspended, it is the second deepest proposition of the Main Reef series, the Simmer Deep holding pride of place in this regard. The deepest of all the mines on the Rand, whether working or idle, is the Jupiter, where a vertical depth of well over 5,000 feet has been reached. The Jupiter and the New Chum Railway Mine, in the State of Victoria, are thus, in all probability, the deepest gold mines in the world.

QUESTIONS OF VALUES AND COSTS.

In the earlier days of these fields, when the flotation of deep level properties was inaugurated, it was repeatedly urged that the increased depth of working would be attended by higher operating costs, and in fact that working expenses would increase in more or less direct ratio to the increase in working depth. One of the principal difficulties which it was in those days supposed would militate against working at great depth was the hoisting of ore and the lowering and hoisting of men and tools. Pumping it was considered would not present any serious difficulties, and although it was rightly deemed there would be increasing loss in transmission of compressed air as greater depths were reached, it was not thought that the operation of underground rock drills either would present many obstacles. It is in connection with hoisting and lowering that difficulties which a dozen years ago were regarded as very serious have been most easily brushed aside. Electric stage hoisting has rendered raising of rock from a depth of about three-quarters of a mile surprisingly easy, and it is very evident to-day that the scale of working and whether sufficient or insufficient labor is available are the factors that determine the cost of working rather than the depth at which ore winning operations are conducted.

SCALE OF WORKING THE CHIEF FACTOR.

To return to the Village Deep in illustration of this statement, it may be pointed out that the cost of operation on the basis of a ton milled for this proposition in March was 15s 7d. per ton, exclusive of development charges, or with development costs 17s. 2d., as against an average of 17s. 3d. for the whole Witwatersrand. The statistics relative to the Simmer Deep Company's operations in March bring out the point even more clearly. At this mine the total cost of working, including development or development redemption charges was 14s. 3d. per ton, or 3s. per ton below the average for the whole field. These figures certainly entitle one to be hopeful as to the probable results of working banket down to a depth of 7,500 feet, provided circumstances in regard to labor, etc., favorable to operation on a large scale, and that healthy working conditions can be maintained down to this depth.
—*South African Mining Journal.*

PROGRESS OF THE GREAT NEW ZEALAND TUNNEL

Mr. S. B. McQuade, Melbourne, Australia, sends us the latest account of the work on the Arthur's Pass tunnel from Otira to Bealey, New Zealand, which has been mentioned from time to time in our pages. This must rank as one of the great tunnel enterprises of the age, it being 5⅓ miles long and driven entirely from the ends. As there is a grade of 1 to 33 it is difficult and costly to keep the upper end drained, so that the work is pushed more rapidly and constantly from Otira the lower end.

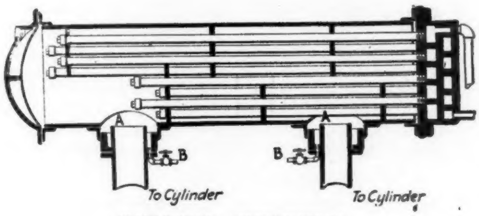
There has been much speculation, says our account, as to when the Otira tunnel will be completed, but most of the views expressed have been too optimistic, for at the present rate of progress it will be fully another five years before this great undertaking is finished. The work has now been in hand well over six years.

The following are the correct chainages of work done from the Otira end to the end of the last week of April:—Bottom heading, 2 miles 22 chains 57 links; top heading (known as No. 8 break-up), 2 miles 6 chains 35 links; walls, 2 miles 2 chains 8 links; lining, 2 miles 1 chain 6 links.

Great things were expected when hammer

drills were installed at the face in the bottom heading in place of the piston drills which had been used previously. While not giving the return that was expected of them the hammer drills are far superior to the piston drills and show up to advantage in hard, heady ground; also there are not so many lost holes.

The progress that is being made is much the same as usual, although the last two weeks have been above the average. Preparations are being made to instal a blower inside the tunnel for ventilation purposes, as the present blower at the tunnel portals has reached its limit. A compressed-air-driven drill sharpener has been installed, which is a great improvement upon the old way of sharpening.



NEGLECTED INTERCOOLER.

LOCATING THE TROUBLE IN AN AIR COMPRESSOR

BY T. G. THURSTON.

A large two-stage, cross-compound air compressor, the discharge pressure being 120 lb. and the receiver or intercooler pressure normally about 30 lb., was hurriedly installed. For a few weeks it ran well, then a knock developed in the high-pressure cylinder. The knock came at irregular intervals and the receiver pressure began to gradually increase week by week.

When the high-pressure discharge and inlet valves were taken out they were corroded and badly gummed, and a large amount of grit and dirt had accumulated on them and in the discharge ports.

The valves and ports were cleaned, the valves replaced, and upon starting the compressor worked a little better, although the receiver pressure did not come down to where it should. A few days later the knock again announced itself and the receiver pressure gradually increased to 60 lb.

The low-pressure journal bearings pounded badly, due to the excessive receiver pressure. Then the high-pressure cylinder was opened and the piston taken out. A piece about 3 in. long was found broken out of each ring and the rings were worn down to 1/8 in. in places. The air passages from the discharge side were filled with a gritty, gummy substance resembling brick dust mixed with oil, and some of it was baked quite hard.

The intercooler was placed horizontally across the two air cylinders, as shown in the illustration. Much water accumulated and found its way into the pockets *AA*, around the air passages leading to the air cylinders. These were provided with pipes and valves for drawing the water off regularly, but this had not been done as often as necessary, and, consequently, the water got into the high-pressure cylinder. Added to this, the air had been taken from the basement directly under the compressor, which was damp and full of dust from the construction work going on.

Two new rings were made for the piston, the air intake was piped to the roof and a trap connected to the two pipes *BB* to insure the water being taken away as fast as formed. When the compressor was started the receiver pressure showed only 27 lb., and the machine ran quietly and has not caused any further trouble.—*Power*.

FREE WATER IN THE PHILIPPINES

A feature which would be unique anywhere else in the world but is common enough in certain locations in the Philippine Islands is the copious supply of excellent artesian waters flowing freely along the highways. The traveler has no need to trouble the housewife for a drink of water, nor the cantina nor the hotel, neither will he find it necessary to trespass upon private property to reach water. The Bureau of Public Works has drilled hundreds of these wells, and several of the provinces have purchased well-drilling machines in order to extend the well system more rapidly. Nearly every town has several of these wells and generally one may be observed at the roadside every few minutes as the traveler passes along. The water is pathogenically pure, clear, sparkling, cool and flowing, which conditions are a natural sequence after the waters have fallen upon the distant and forest-covered sierra, and have percolated for miles through the porous stratum to the perforation made by the bit of the well-drilling machine. Thus, it may be observed that ample facilities to obtain potable water exist for man and animal, and for motor cooling.

FILTRAS

This is a new filtering medium promising to be of great value. The standard Filtras tile is 12 by 12 by 1½ in., but it can be produced in various shapes and sizes. The material is essentially silica; it easily stands any temperature up to 1600F., is practically unaffected by acids or by such weak alkalies as are in use where filtration is required. The ware is white and porous, of excellent hardness and strength and may be made in various degrees of porosity. Normally the pores are so fine as to offer great resistance to the penetration of even the finest slimes, yet the mass is itself so porous as to allow comparatively free passage of gases or liquids to be filtered.

The remarkable uniformity in the porosity of the tile is to be noticed, particularly important as this is in problems involving aeration and agitation. The following data of air rating tests will give an indication as to this porosity. These show, the number of cubic feet of air per minute per square foot of area that at the low pressures given passes through the standard tile 1½ in. thick.

	Cu. Ft. of Air at 2-In. Water Pressure.	Cu. Ft. of Air at 4-In. Water Pressure.
Specimen 1..	12.0	24.5
Specimen 2..	11.7	22.8
Specimen 3..	11.4	22.7
Specimen 4..	11.7	22.7
Specimen 5..	12.0	23.0

DUST AND BACTERIA IN THE AIR

At the Woolworth building, in New York, the air at the street level on July 2, 1913, contained 221,000 dust particles per cubic foot; at the tenth story, 85,000; at the thirtieth story, 70,000, and at the fifty-seventh story, 27,000. As a figure of comparison, the air over Long Island Sound at a point several miles from shore, was found to contain 18,000 dust particles per cubic foot.

At the John Hancock building in Boston on June 5, 1913, the air near the sidewalk contained 1,330 bacteria and 20 molds per cubic foot, while at the tenth story the corresponding numbers were 330 bacteria and 3 molds per cubic foot. The elimination of the horse from city streets is helping to reduce the organic dust, but the automobile is itself a dust-creator when used on road surfaces not adapted to its weight and speed.

HE TOOK CHANCES AND CHANCE TOOK HIM

BY BERTON BRALEY.

Here lies Antonio Herrowitz,
Or what is left of him.
He was a man of splendid build,
Of vigor and of vim.

He never feared to take a chance,
Wherever he might be;
He'd take a chance the roof was safe,
He would not look to see.

He'd use a drill to tamp a charge,
And take a chance on that;
He'd smoke in any gassy place
He happened to be at,

And when he rode upon the cage
He would not grasp the bar;
He never looked upon the board
Where rules of safety are,

But, being full of health and strength,
And quite devoid of fear,
He played at hide and seek with death,
And now he's lying here.

He took a chance with dynamite,
He took a chance with damp,
And in the very prime of life
Fate snuffed his miner's lamp.

He's done with taking chances now,
He's done with mines and such,
And what is left of him lies here;
He took one chance too much.

—*Coal Age.*

For switching purposes at the Cleveland ore docks, with a view to avoiding the inclusion of the switching engine among the cars being moved, the Pennsylvania Railroad has introduced locomotives which have the peculiarity that they do not run on the same lines as the cars they handle, but on narrow gauge parallel lines. Each engine has an arm on each side which can be lowered by means of compressed air controlled from the cab, and acts as a pusher. The locomotives are of Baldwin-Westinghouse make and are 25 tons in weight. Power is obtained from two rails lying inside the rails on which the locomotives operate; these rails are protected by a wood covering.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

W. L. SAUNDERS, - - - - - Editor
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W. C. LAROS, - - - Circulation Manager

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A NOVEL AND UNIQUE TUNNEL RECORD

The account given elsewhere in the present issue of COMPRESSED AIR MAGAZINE of the driving of the Spearfish Creek tunnel of the Homestake Mining Company calls attention again to the entire incomparability of different tunnel driving records as conclusive evidence upon any question of efficiency of performance. The conditions differ in so many cases from those of other apparently similar undertakings that when comparisons are attempted there are always factors which can be cited for excuse or apology if required.

The tunnel here spoken of was not a railroad tunnel nor up to the usual cross section dimensions with which we are most familiar, although a tunnel in which three men could walk comfortably abreast, with a yard of head room to spare, before the concreting, is not unworthy of consideration.

The record made in this tunnel, considering the headings individually, will not be cited as a time or speed record, although who can tell us of another tunnel more than four miles long holed through in a little more than a year? Time was apparently not so imperative a consideration in this case, if only the tunnel or flume was ready when the other details of the water power installation were completed. The conditions under which the work was done must be regarded as unusually favorable There was practically no hoisting required anywhere on the job nor even power haulage. All material and supplies were delivered with comparatively slight cost precisely where and how convenience dictated, and there were convenient dumps on the level for all the spoil removed. The rock was so solid that little timbering was required, and there was little trouble about water and little expense for removing it.

Electric current was readily available for the work at slight cost, thus almost compelling the adoption of this means of power transmission, yet, curiously enough, it is to this circumstance that the unique and remarkable record made is to be attributed, and it is a fortunate circumstance that the data regarding the power consumption are so complete and indisputable. The horsepower used rarely exceeded 30, and averaged below that. For the driving of sixteen headings, with drills and blowers and some pumping, ten times this amount of power, or

even more than that, would have been the familiar figure.

Here surely is a world record for power consumption as compared with accomplishment in this line of work, and with so little margin left for possible future power saving in tunnel work it may be considered a record likely to stand unrivaled for all time.

This great actual saving of power, and therefore of power cost, is an important item in making up the cost of the entire work, and it is to be regretted that we could not have been favored with detailed figures on this point also. It is apparently quite probable that in total cost also a record was made, but in this particular comparisons with the costs of other enterprises would have been more difficult. At any rate the record made and indisputably recorded in this case deserves to be studied as to the means and methods employed, and these should find favor in future work of the kind. Power especially is an important item in many cases and a saving in that brings other savings in its train.

PNEUMATIC MINE TRACTION

In the June issue of COMPRESSED AIR MAGAZINE we reprinted from Iron and Coal Trade Review an enthusiastically written account of the use of high pressure, triple expansion pneumatic locomotives in European coal mines. It will be remembered that quite extravagant claims were made by the writer as to the economy and efficiency of the system described. The article was in fact written in the spirit of a boy with a new toy and the editor without leaving his desk accepted the story at its face value and without the discounts which are so imperative in such a case.

The new toy feature just alluded to seems to have been especially pronounced in this case. It must be evident that the system so lauded has not yet passed the time test, since the developments spoken of have occurred within a couple of years. The high initial cost of plant, the corresponding maintenance cost, the reliability and safety risks of five stage compressors, excessively high storage pressure and triple expansion locomotives may mark a transition or tentative system rather than one that is finally and generally to be adopted.

For instance, according to the story, the Europeans seem to have discovered the use of compound locomotive cylinders with atmospheric inter-heaters just four years ago, while an American inventor applied for a patent for the same arrangement ten years ago. The possible values of the extremes now exhibited in European practice have been investigated and a mean has been established in this country which is proving highly satisfactory.

THE INTERNATIONAL ENGINEERING CONGRESS AT SAN FRANCISCO IN 1915

The Panama-Pacific International Exposition, from the twentieth to the twenty-fifth of September, 1915, will be the meeting place of a large body of distinguished engineers. The assemblage, to be known as the International Engineering Congress, will be presided over by Col. George W. Goethals, who has accepted the office of honorary president. Thousands of civil, mining, mechanical, marine and military engineers and naval architects, from many different nations and representing hundreds of affiliated bodies, have declared their intention of attending the congress. It is to be conducted under the auspices of five national associations, viz.: the American Society of Civil Engineers, The American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the Society of Naval Architects and Marine Engineers, assisted by a committee of distinguished engineers of California.

COMPRESSOR INSTALLATION FOR FIRE ALARM WHISTLE

We have received a number of inquiries concerning the use of compressed air for fire alarm whistles. The National Electric Light Association Bulletin for June gives some information in this line, the most prominent item being the following from A. F. Nelson, Edison Electric Illuminating Company, Brockton, Mass.

This company, he says, has a compressed air system, electrically operated, for blowing a whistle fire alarm in a town of 6000 inhabitants. The service, 220 volt, is supplied through a Westinghouse, Type J, Form I, traction brake governor to a Wagner single-phase, 208 volt, 1650 rpm., 7½ hp. motor, gear connected to a 6 in. by 6 in. Ingersoll-Rand, Class E, compressor. The air is stored in three 10 ft. by 4 ft. cylindrical tanks at 100 lb. pressure.

There is a 2½ in. pipe leading to the whistle on the roof. The whistle is operated by a Gamewell whistle machine. Outside the building the pipe and valve to the whistle are boxed in, clear up to the base of the whistle, and a steam coil is placed inside this box to keep the piping and valve from freezing. This system has been installed seven years and works well. The pump has had an average consumption of a little less than 2000 kw.-hr. per year.

HIGH ECONOMY IN AUTOMATIC CONTROL

Agitation plants, pulsating jigs and other apparatus, which have recently become features of modern concentrating mills and cyanide plants, have led to the installation of separate compressors especially adapted to the purpose. These are now commonly motor driven and include provision for automatic control which enables the compressor to be started up when air is needed and shut down as soon as the volume of air in the receiving system, and consequently the air pressure, has reached a pre-determined limit. These compressors take very little power, as they are only using current when air is needed and they have proved to be extremely economical both in operation and upkeep.

FIRST DISCOVERY OF COAL IN AMERICA

Joliet and Marquette in the year 1673 returning from their tour of exploration in search of the Mississippi or as it was then known "The Great River," came up the Illinois river on their way to what is now Chicago. When in the vicinity of the present city of Utica, they discovered an exposed outcrop of seam No. 2 and were also informed by the Indians that the "stones" would burn.

There is some question regarding the exact location of the exposure of the seam, whether it was east or west of Utica. It of course was not at that place because the great La Salle anticline which brings the St. Peters sandstone to the surface, as exemplified by Starved Rock, had raised the coal seam to a considerable elevation and so exposed it to the eroding influences that it was entirely worn away over a considerable area. This resulted in an outcropping to the west near La Salle and another east of Utica, and it was one of these croppings that Joliet and Marquette observed.

Seam No. 2, also known in the north as the Third Vein and in the south as the Big Muddy and New Kentucky coal, is the only seam in Illinois that has been traced for a considerable distance by geological evidence only.

THE AIR TOWEL

Agitation for the suppression of the roller or common towel for public use has swept over the entire country, as it is considered a menace to public health. Shortly after the elimination of the public drinking cup by all authorities, the crusade on the common towel in public places started, and some ten months ago Massachusetts, Ohio, and Michigan passed laws prohibiting its use; since then more than thirty States have made similar laws. The common towel was succeeded by the paper towel, the use of which requires, besides the initial expense of the towels, an attendant to supply fresh and remove soiled and wet towels from the lavatories; now the last word in economical and sanitary innovations is the "air towel" used in the large public lavatory in the District Building at Washington, D. C. This "air towel," or electric hand drier, is the invention of J. M. Ward, superintendent of the District Building. In appearance it resembles a rectangular box 11 by 13 inches set on a sanitary base having 12-inch legs, with an opening in the top of the case in which the wet hands are held while being dried. The device consists of a blower that forces air through an electric heating element to ducts and deflectors suitably placed for distributing the warmed air to all parts of the hands at the same time, and is operated by a foot lever or pedal, which in turn operates a quick-acting switch, thereby setting the blower in motion; by removing the foot the device is put out of operation; the hands come in contact with no part of the device, thus assuring a perfectly sanitary operation. It takes just 30 seconds to dry the hands, and although this seems long while standing with the hands in the drier and practically unoccupied, tests have shown that the ordinary operation of drying the hands with a towel consumes more time if the hands are to be dried as thoroughly as by the electrical drier. Being dried perfectly there is no unpleasant sensation.—*Scientific American.*

NOTES

W. R. Grace & Co., of New York, have purchased of the F. M. Davis Iron Works of Denver a portable three-stamp mill for exportation to the mountains of Bolivia. The mill is sectionalized for muleback transportation.

The horse power required for pressure blowers capable of supplying 100,000 cu. ft. of air per minute in a mine, at a pressure of 12 oz plus the power required to overcome friction in pipes, is 600 to 650 hp., depending upon the length of the pipes.

A miniature of the Panama Canal, built on a scale of 6½ ft. to the mile, is to be operated at San Diego, Cal., during the exposition next year. A contract for constructing the model has been awarded. The cost is estimated at no less than $250,000.

To feed an average of 800 natives at the Lonely Reef mine in Rhodesia, in 1913, with bread, beans, mealies (corn), monkey nuts, rice, green vegetables, rations, salt, meat, sugar, cocoa, kaffir corn, milk, and maizena, cost a total of $36,500, equal to about $46 per head per year.

The total lift through locks of the Barge Canal is 16 times that of the Panama Canal, and it has 10 times the number of dams, 14 times as many locks, and 20 times as many structures. The cost, as far as construction and engineering are concerned, will be within the estimates, this, perhaps, being the greatest wonder of all.

The House at Washington unanimously approved the item in the sundry civil bill appropriating $150,000 to start the work on the new Bureau of Mines buildings in Pittsburgh. The total authorization for the work is $500,000, the remaining $350,000 to be appropriated at the short session in December should the money be needed.

So little is refrigeration needed in Ireland that the entire ice supply of the south and west portion of the Emerald Isle is manufactured by a single establishment in Cork, and amounts to only six tons per day. In addition to this there are two breweries, a chilled meat concern, and a butter factory with perhaps one or two other individual firms which have their own separate ice-making plants.

A black bug or beetle, locally called the slag-bug, is found around the Montana smelters in the summer, and its favorite place of attack is the back of the neck of the smelterman, where its nip or pinch causes some discomfort and strong language. A similar insect is found at Kalgoorlie, Western Australia, where it delights in diving into heaps of hot ash from boilers and roasting furnaces. It also nips hard and goes under the name of slag bettle, asbestos beetle, or salamander.

What is claimed to be the largest air compressor so far employed in the coal-mining industry of Germany has been completed by the Frankfurter Maschinenbau Gesellschaft (Pokorny and Wittekind), of Frankfort-am-Main, for the Werne Collieries of the Georgs Marienhütte Gesellschaft. The machine, which runs at a speed of 82 revolutions per minute, compressing to eight atmospheres, has a capacity of over 10,000 cu. ft. of free air per minute.

The Hohenzollern Canal, opened on June 17 by the German Emperor, and which joins the rivers Oder and Spree, brings Berlin, the German capital, into water communication with Stettin and the Baltic Sea, 150 miles away. The completion of this canal, the history of which dates back to 1669, marks an epoch in the development of German inland waterways that radiate in every direction and solve the problem of cheap transportation in Germany.

George D. Whitcomb, an inventor of mining machines and founder of the George D. Whitcomb Co., of Rochelle, Ill., died in California on the 21st ult., in his 80th year. He retired from business several years ago. He developed the Harrison mining machine, the first successful machine of the puncher type put on the market, and later organized a company to exploit his invention. Mr. Whitcomb was a coal operator before engaging in the manufacture of mining machines and was well known to the older generation of coal men.

An installation of Humphrey pumps has been ordered by the Egyptian Government for the drainage of Lake Mareotis at Mex, near Alex-

andria. When completed, this plant will be one of the largest pumping installations in the world, and will consist of 18 pumps, each capable of delivering 120,000,000 gal. per day through a lift of 20 ft. The combustion chamber of the pumps will have a maximum internal diameter of 8 ft. 8 in., and its height will be about 14 ft. The water valve box will be 8 ft. 8 in. diameter and 7 ft. high, and will be fitted with 100 valves of the hinge type.

The coal fields of Northumberland and Durham counties claim to be the oldest in production of any coal fields in England. It is a historical fact that these fields have been worked for at least 700 years. Every kind of coal, with the exception of anthracite, is found in these two counties. It is estimated that one-tenth of the population of Durham county is connected, in some capacity, with that industry, and that the county's output of coal in 1913 was valued at $100,000,000. There are nearly 500 coal mines in these two counties, and in 1913 there were shipped in coastwise and foreign vessels 30,791,687 tons. Of this amount Newcastle shipped practically one-half, or 15,095,055 tons.

The danger of the carbide lamp as a source of accident is not wholly appreciated. While less likely to be the cause of an underground fire than is the candle, it is also capable of inflicting more or less serious accidents by itself. Thus, in the March *Safety First*, of the Nevada Consolidated, two minor accidents attributable to carbide are described. In one case, a man was changing carbide in his lamp after dark near an open light when the generated gas exploded and burned his face. In the other case, a quantity of spent carbide was emptied where a leak in a pipe line had made a puddle of water. A laborer threw a rail from his shoulder into the puddle and the mud of exhausted carbide, practically hydrate, was splashed in his face and injured his eyes severely.

It is estimated that there are fully 50,000 amateur wireless telegraph operators "butting in" all along the Atlantic coast, and when there is a large group of them in any one place they drown out the long-distance over-sea messages. In fact, this has got to be such a nuisance that regular operators can't count on long-distance work until after midnight when the air becomes clear. Besides being a bother, this promiscuous sending of messages where practical jokers are included may become a positive menace, for if a fake distress signal is sent out there is no way to prove it's a fake.

At Czuchow, in the coal field of Upper Silesia, is the deepest well in the world. It has reached a depth of over 7,348 ft., a trifle under a mile and a half below the surface. America has three wells ranking next in order. That near McDonald, Pa., some 10 miles southeast of Pittsburgh, is 6,860 ft. deep; one in Putnam Heights, Conn., is 6,004 ft. deep, and one now being bored at Derrick City, Pa., has reached the depth of 5,820 ft. Although each of these wells is over a mile in depth, little that is new in geologic formation has been learned from the borings.

The mass of the sun is 332,800 times the mass of the earth, the respective diameters being 865,000 and 7918 miles. A body weighing 100 lb. on the earth's surface, would be about 3000 lb. on the sun. Think of going fishing there and having to lug home a basket of sunfish.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

JUNE 2.

1,098,389. APPARATUS FOR WASHING SMOKE, AIR, AND OTHER GASES. GEORGE LISTER, Tow Law, England.

1,098,406. MEANS FOR USE IN STARTING INTERNAL - COMBUSTION ENGINES OF AUTOMOBILES. ALFRED ARNOLD REMINGTON and ARTHUR JOHN ROWLEDGE, Birmingham, England.

1. In a four-stroke cycle internal combustion automobile engine having not less than four cylinders, a receiver into which compressed air is admitted from a suitable source, air distributing valves which correspond in number to the motor cylinders of the engine, cams for operating the said distributing valves in turn and themselves carried by a shaft which revolves at half speed of the engine, and means, operable entirely independently of any portion of the main valve mechanism, in position between the starting cams and the valves, by which, at will, the cams and said distributing valves may be put into and out of operative relation to one another, respectively, leaving the valves closed when the cams are out of operative relation thereto, for the purpose set forth.

1,098,440. ROTARY BLOWER. GEORGE C. HICKS, JR., and RALPH C. ENYART, Connersville, Ind.

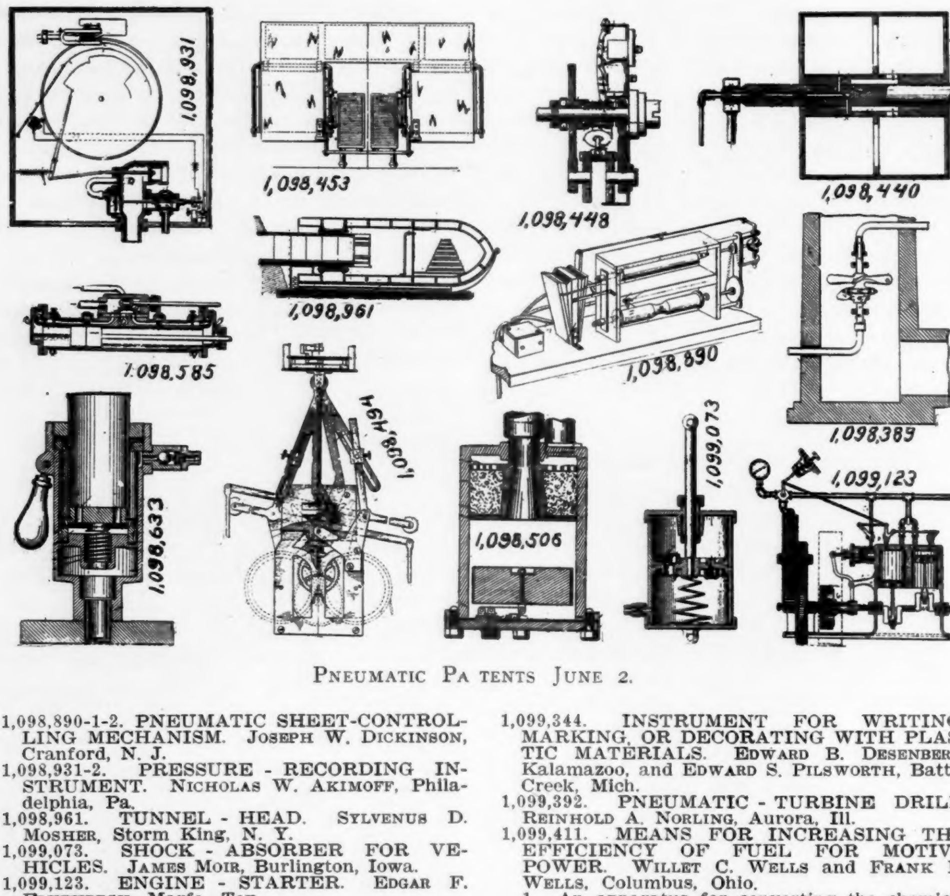
1,098,448. ENGINE - STARTER. HENRY M. KINSLOW, Santa Ana, Cal.

1,098,453. FEEDER-BELLOWS. FRANK G. LYNDE, Newark, N. J.

1,098,474. MACHINE FOR MAKING AND SHARPENING ROCK-DRILLS AND FOR GENERAL FORGING. CARL BROWN, Denver, Colo.
1,098,494. PNEUMATIC CLOCK MECHANISM. AUGUSTUS T. HAHL, Chicago, Ill.
1,098,506. AIR-DRYING APPARATUS. SAMUEL H. KELM, Salem, Ill.
1,098,585. FLUID DOOR-CONTROLLER. EDWARD N. MILLS, San Francisco, Cal.
1,098,616. PRESSURE-REGULATOR. JOHN L. CREVELING, New York, N. Y.
1,098,633. AIR-PUMP. VERNON H. MEYER, Cleveland, Ohio.
1,098,690. DRILL. MATHER W. SHERWOOD, Franklin, Pa.
1,099,141. VACUUM CLEANING-TOOL. EUGENE M. KENT, Rome, N. Y.

JUNE 9.

1,099,161. TRANSMISSION MEANS. WILLIAM E. BROWN, Milwaukee, Wis.
1,099,170. PROCESS FOR INCREASING THE PRODUCTION OF OIL-WELLS. IRWIN L. DUNN, Marietta, Ohio.
1,099,242. LUBRICATOR FOR PNEUMATIC APPARATUS. EDWIN A. EMERY, Denver, Colo.
1,099,286. TRIPLE VALVE. FRANK H. DUKESMITH, Pittsburgh, Pa.
1,099,287. CONTROL-VALVE FOR TRIPLE VALVES. FRANK H. DUKESMITH, Pittsburgh, Pa.



PNEUMATIC PA TENTS JUNE 2.

1,098,890-1-2. PNEUMATIC SHEET-CONTROLLING MECHANISM. JOSEPH W. DICKINSON, Cranford, N. J.
1,098,931-2. PRESSURE - RECORDING INSTRUMENT. NICHOLAS W. AKIMOFF, Philadelphia, Pa.
1,098,961. TUNNEL - HEAD. SYLVENUS D. MOSHER, Storm King, N. Y.
1,099,073. SHOCK - ABSORBER FOR VEHICLES. JAMES MOIR, Burlington, Iowa.
1,099,123. ENGINE - STARTER. EDGAR F. FRUEHBECK, Marfa, Tex.

1. A device of the character described including a fluid pressure turbine and means for applying fluid under compression thereto, whereby said turbine is rotated, a shaft, means operatively connecting said turbine with said shaft, an engine fly wheel, a rotatable member in operative connection with said fly wheel and loosely mounted on said shaft, a clutch member slidably mounted upon the shaft, but fixed against relative rotation thereon, a mechanism operatively connected with the clutch member and normally holding said member in engagement with the rotatable member carried by said shaft and means for applying fluid pressure to said mechanism whereby said clutch member is disengaged from said rotatable member.

1,099,344. INSTRUMENT FOR WRITING, MARKING, OR DECORATING WITH PLASTIC MATERIALS. EDWARD B. DESENBERG, Kalamazoo, and EDWARD S. PILSWORTH, Battle Creek, Mich.
1,099,392. PNEUMATIC - TURBINE DRILL. REINHOLD A. NORLING, Aurora, Ill.
1,099,411. MEANS FOR INCREASING THE EFFICIENCY OF FUEL FOR MOTIVE POWER. WILLET C. WELLS and FRANK E. WELLS, Columbus, Ohio.

1. An apparatus for converting the chemical energy of fuel into mechanical force by expanding compressed air by the heat and gases of combustion, supported by said compressed air comprising a furnace in which said combustion takes place, an air compressor arranged to supply to said furnace a variable volume of uniformly compressed air, a motor in direct communication with said furnace operated by the heat expanded compressed gases therefrom, and a governor adapted to regulate the flow of said gas from said furnace to said motor.

1,099,457. REGULATOR FOR FLUID-COMPRESSORS. FREDERICK V. D. LONGACRE, Yonkers, N. Y.
1,099,483. FLUID-OPERATED TOOL. LEWIS C. BAYLES, Easton, Pa.

1,099,557. ART OF PREPARING DISINTEGRATED MATERIALS FOR PACKING. WILLIAM A. LORENZ and JOSEPH MERRITT, Hartford, Conn.

1. The method of preparing food seeds for market which consists in disintegrating said seeds, withdrawing the free air from the seeds while they are being disintegrated, and feeding the disintegrated product with the free air withdrawn to a packing receptacle.

1,099,560. PORTABLE VACUUM-CLEANER. LOUIS D. MATCHETTE, Milwaukee, Wis.

1,099,585. AUTOMATIC CAR AND AIR COUPLING. HARRY F. WOERNLEY, Pittsburgh, Pa.

1,099,670. PNEUMATIC - TOOL RETAINER. EDWARD J. SHOFFNER, Roanoke, Va.

1,099,680. PNEUMATIC-CLEANER CONTROLLER. EDGAR F. WEIRICH, Milwaukee, Wis.

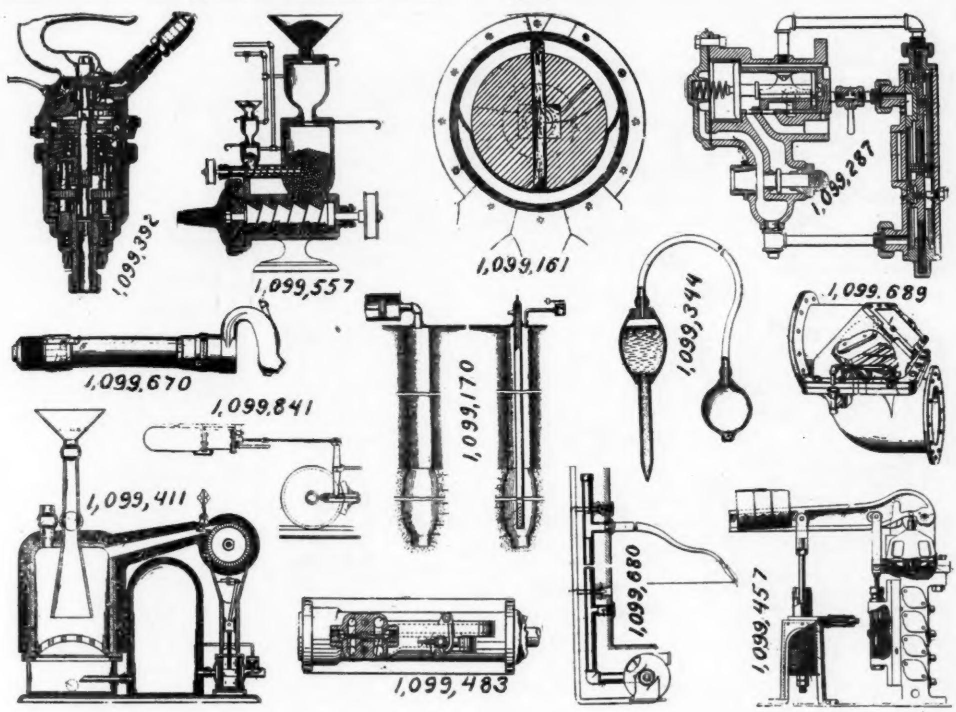
1,100,028. VACUUM DRYING APPARATUS. ALBIN RAVAUTTE, Marseille, France.

1,100,056. AIR-PUMP FOR AUTOMOBILES. CHARLES N. COLSTAD, Atlantic, Mass.

1. The combination with an internal combustion engine, of a fan-supporting bracket sustained thereby, an engine-cooling fan supported by said bracket, engine-operated fan-driving mechanism, said bracket having a pump cylinder formed as an integral part thereof, a pump piston operating in said cylinder, and means to operate the piston from the fan-driving mechanism.

1,100,071. ROCK-DRILL. LOUIS W. GREVE, Cleveland, Ohio.

1,100,109. AIR-COMPRESSOR. GLENN N. WILKINSON and FRED M. HAMILTON, Battle Creek, Mich.



PNEUMATIC PATENTS JUNE 9.

1,099,689. ATMOSPHERIC RELIEF-VALVE. FRANK S. BROADHURST and LOUIS L. PRATT, Philadelphia, Pa.

1,099,841. AUTOMATIC AIR-BRAKE FOR RAILWAY-CARS. WILLIAM G. CANION, El Paso, Tex.

JUNE 16.

1,099,957. SOLDERING-TOOL. CHARLES WILLMOTT, Smethwick, England.

1,099,977. PUMP. JOHN FOURNIA, Albany, N. Y.

1. The combination of a reciprocative pump, a motor for operating the pump, and means operated by the fluid pressure developed in the pump for increasing the power applied by the motor to the pump on the work stroke of the pump and decreasing the power on the suction stroke of the pump.

1,099,973. ACETYLENE-TORCH. GEORGE H. DYER, Somerville and JOHN W. WHITFORD, Boston, Mass.

1,099,994. PNEUMATIC ROCK-DRILL. GAYLORD A. ORR, Cripple Creek, Colo.

1. In an air compressor comprising two concentric pistons and cylinders, the outer cylinder having an exhaust port controlled by the outer piston, the inner cylinder being open at one end to atmospheric pressure and having at the opposite end a port leading into the outer cylinder and controlled by the inner piston, the pistons of both cylinders operating in unison.

1,100,126. PROCESS OF AND APPARATUS FOR AERATING AND FEEDING LIQUID FUEL. SAMUEL J. EVA, HENRY P. GRAY, and JAMES ROBERT CHRISTY, Oakland, Cal.

1. In the art of preparing and feeding aerated liquid fuel, the process of continuously spraying by external pressure liquid fuel into an aerating chamber at the top, continuously supplying to said aerating chamber air under pressure greater than atmospheric, continuously drawing out from said chamber, near the bottom thereof, the aerated liquid fuel at a rate not greater than that at which it is supplied thereto, and automatically removing from the liquid fuel so aerated any excess thereof above a predetermined amount.

1,100,144. MEANS FOR HUMIDIFYING AND WASHING AIR. WILLIAM C. H. NOBLE, Los Angeles, Cal.

1,100,230. RIVETING-TOOL. ULYSSES G. DETWILER, Verona, Pa.

1,100,260. PROCESS OF OBTAINING LIQUID HYDROCARBONS. EMIL SCHILL, New York, N. Y.

1. The process of separating the pentanes from a volatilized mixture of hydrocarbons which comprises subjecting such mixture to pressure in the presence of a finely divided heat absorbing agent, liquefying such of the compressed gases as normally volatilize at temperatures above approximately 25 degrees C., maintaining in the liquid thus produced the condition of its creation, distilling the pentanes from said liquid, liquefying same and storing same under seal.

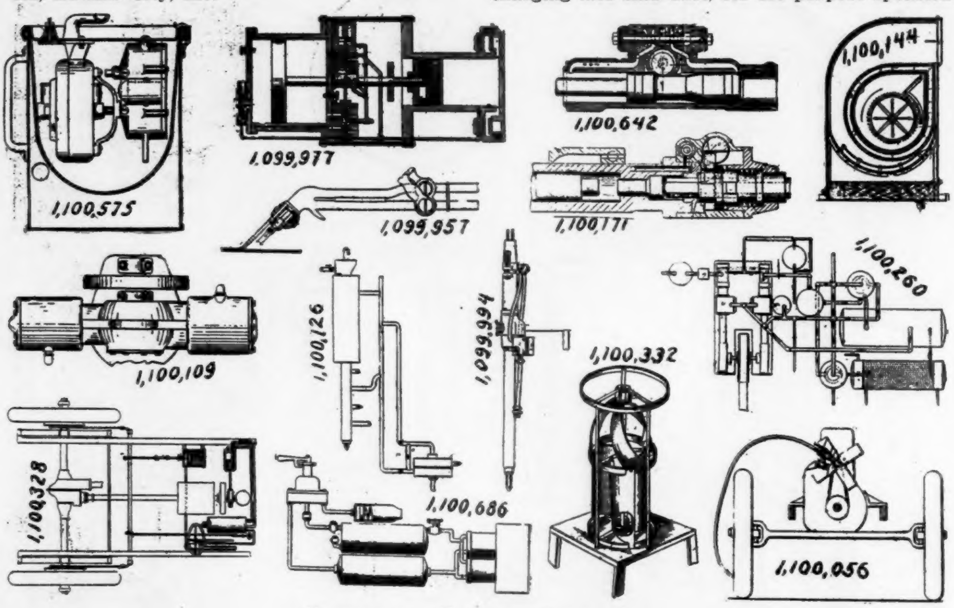
1,100,328. AIR-BRAKE PUMP. JOHN SCHMID, JR., Kansas City, Mo.

1,100,688. FLUID - PRESSURE - PURIFYING SYSTEM. GEORGE M. SPENCER, St. Louis, Mo.

JUNE 23.

1,100,705. APPARATUS FOR DISCHARGING ASHES AND OTHER MATERIALS FROM SHIPS. WILLOUGHBY LAKE BAYLAY, Blackheath, England.

3. In apparatus for discharging refuse from ships, the combination with a water pipe having a sub-aqueous discharge end and means to maintain a constant stream through said pipe under all conditions of operation; of a receptacle for refuse, a duct discharging into said pipe, a valvular device for receiving refuse from said receptacle and delivering the same to said duct while preventing at all times communication between the duct and receptacle, and means to supply compressed air to said valvular device when discharging into said duct, for the purpose specified.



PNEUMATIC PATENTS JUNE 16.

1,100,332. WINDMILL. JAMES B. SMITH, San Saba, Tex.

1,100,568. PNEUMATIC ACTION. HENRY H. HOLTKAMP, Lakewood, Ohio.

1,100,575. VACUUM-CLEANER. JAMES B. KIRBY, Cleveland, Ohio.

1,100,605. FLUID-MOTOR. ARTHUR GEORGE LLOYD NEIGHBOUR, Beaumaris, Victoria, Australia.

1,100,611. PNEUMATIC PLAYER. GUSTAF W. PAULSON, Belmont, and RUDOLF PAULSON, Boston, Mass.

1,100,642. VALVE. FRANK E. WILLEY, Claremont, N. H.

1,100,675. PROCESS OF ELIMINATING IRON FROM LIQUIDS. HEINRICH HACKL and HUGO BUNZEL, Heufeld, Germany.

1. A process of recovering values from a solution containing ferrous salts, zinc salts, and sodium sulfate, a part at least of said zinc and iron salts being in the form of chlorids, which comprises adding thereto a relatively small amount of a copper compound, blowing air through said liquor until the oxidation of the iron and copper compounds is substantially complete, a compound capable of neutralizing acid being present in the liquor during the oxidation of the iron.

1,100,677. AIR CLEANSING AND HUMIDIFYING MACHINE. HARVEY E. LEACH, Miles City, Mont.

1,100,717. TREATING OIL. JESSE A. DUBBS, Pittsburgh, Pa.

1. As an improvement in the art of distilling hydrocarbons, the method herein described which consists in heating the material to a point at which the hydrocarbons would be broken up if mingled with air, forcing air through the same and maintaining the heat by the chemical reaction produced.

1,100,825. FLUID-OPERATED TOOL. LOUIS W. GREVE, Cleveland, Ohio.

1,100,867. APPARATUS FOR TRANSMITTING AND INDICATING FLUCTUATING PRESSURES OF WATER, GAS, AND STEAM. MACDOUGALD DEXTER, Columbus, Ga.

1,100,940. AIR-CLEANING MACHINE. HOWARD S. F. BARNER, Allentown, Pa.

1,100,959. FODDER - CUTTER DISCHARGE-PIPE. JOSEPH DICK, Canton, Ohio.

1,100,992. COMBINATION SUCTION ELEVATOR AND LOADER. ROBERT A. SALLEE, Middletown, Cal.

1,101,102. INTERMEDIATE STOP DEVICE FOR PNEUMATIC ELEVATORS. GEORGE F. STEEDMAN, St. Louis, Mo.

1,101,120. RAILWAY SIGNALING APPARATUS. CLYDE J. COLEMAN, New York, N. Y.

1,101,143. VACUUM-PUMP. HARRY NEVILLE, New York, N. Y.

1,101,173. PIANO - PLAYING PNEUMATIC ACTION. ROBERT A. GALLY, Cincinnati, Ohio.

1,101,225. GAS-REGULATING VALVE. HARRY E. WOLF, Webster Groves, Mo.

1,101,248. APPARATUS FOR TREATING TEXTILE FIBERS WITH LIQUIDS AND GASES. JOHN BRANDWOOD, THOMAS BRANDWOOD, and EDWARD BRANDWOOD, Bury, England.

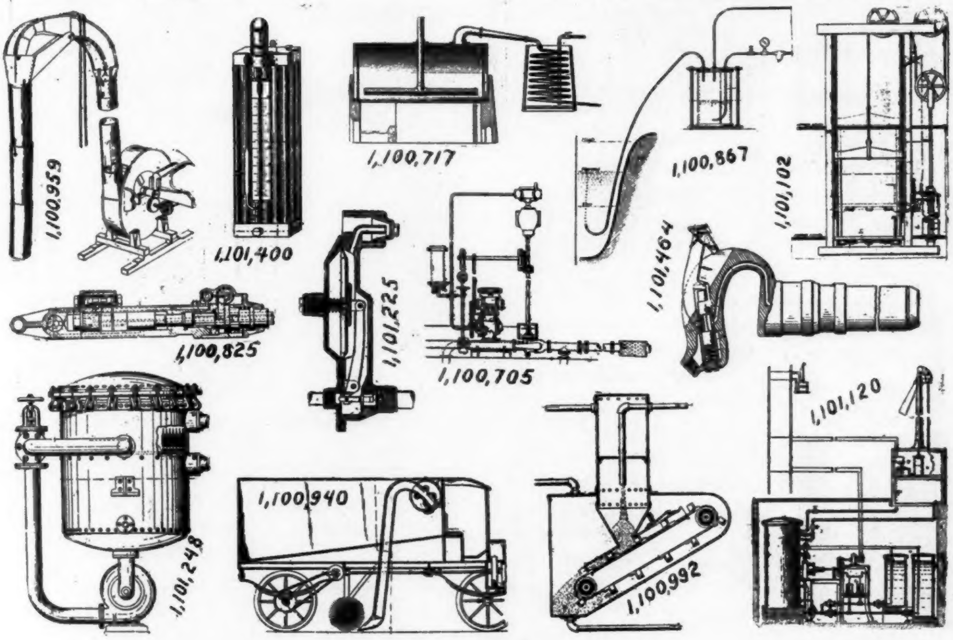
1. Apparatus for first treating cops with liquid and then treating them with air without removing them, such apparatus comprising a keir, a transverse partition therein for bearing the cops and dividing the keir into upper and lower compartments of which the lower is the larger, a liquid circulating pump and its pipes, air and liquid inlets to the upper compartment, and air and liquid outlets in the lower compartment, substantially as set forth.

1,101,400. APPARATUS FOR ASCERTAINING THE DEGREE OF PURITY OF AIR. JUAN CALAFAT Y LEON, Madrid, Spain.

1,101,787. APPARATUS FOR REGULATING THE AIR-SUPPLY FOR GAS-PRODUCERS. HENRY L. DOHERTY, New York, N. Y.

1,101,789-90. METHOD OF BURNING LIQUID FUELS. HENRY L. DOHERTY, New York, N. Y.

1. The process of burning liquid hydrocarbons to effect decomposition of materials, which comprises, atomizing the said liquid hydrocarbons by a jet of air under pressure, conducting the mixture of atomized hydrocarbons and air into a refractory-walled chamber, subjecting the hydrocarbons of said mixture to partial combustion in said chamber to convert said hydrocarbons into combustible gases and to heat the gases produced to a comparatively high temperature, introducing into the hot combustible gases produced by said partial combustion a further portion of air diluted with gases derived from the decomposition of said materials, whereby the



PNEUMATIC PATENTS JUNE 23.

gases produced by said partial combustion are subjected to slow combustion, and conducting the slowly burning gaseous mixture into contact with said materials.

1,101,464. SAFETY DEVICE FOR PNEUMATIC HAMMERS. CHARLES F. MCDONALD, Philadelphia, Pa.

JUNE 30.

1,101,558. APPARATUS FOR VACUUM-CLEANING. HIRAM STEVENS MAXIM, West Norwood, England.

1,101,572. PROCESS OF MAKING CANDY. PETER H. SCHLUETER, Chicago, Ill.

1. The process of making candy which consists in cooking a solution of cane sugar and a reversion preventing agent at atmospheric pressure to a temperature higher than the cracking point but insufficient to complete the cooking operation and in then subjecting the batch to a vacuum until cooked without raising the temperature above that attained at atmospheric pressure.

1,101,698. AIR - GUN. ARTHUR ADELBERT KARCHER, St. Joseph, Mich.

1,101,708. MEANS FOR INFLATING PNEUMATIC TIRES OF MOTOR-CARS AND OTHER VEHICLES. NIELS A. NIELSEN, Marton, New Zealand.

1,101,784. SYSTEM FOR CONTROLLING THE HUMIDITY AND TEMPERATURE OF AIR. WILLIS H. CARRIER, Buffalo, N. Y.

1,101,901-2. HUMIDIFYING APPARATUS. WILLIAM G. R. BRAEMER, Camden, N. J.

1. The herein described method of obtaining humidified air having substantially constant humidity, which consists in treating the fresh air to an aqueous vapor to impart to it approximately the humidity required, simultaneously collecting a plurality of samples from different portions of the flowing body of humidified air taken at substantially the same transverse section of the conduit through which the air is flowing, mixing the several samples to provide a common average sample of the humidified air, and varying the temperature of the fresh air before it is subjected to the aqueous vapor under the control of the condition of the average sample of humidified air, whereby the humidity of the treated air may be maintained substantially constant.

1,101,919. PNEUMATIC AND SELF-PLAYING MUSICAL APPARATUS. ROBERT A. GALLY, Brooklyn, N. Y.

1,101,929. COMPRESSOR FOR GASES. ROBIN A. HAYES, Edgbaston, England.

1,101,950. OUTSIDE TUBE-CLEANER. James Ogg, Pahala, Hawaii.

1. A tube cleaner, consisting of a cylindrical body to slip over a tube, said body carrying an internal sleeve member, an annular rotor mountable on the sleeve member, an annular nozzle ring on the sleeve, a fluid pressure chamber delivering fluid through the nozzle ring to the rotor, scrapers carried by the rotor, a manifold disk, and pipes connecting the chamber and the manifold disk with said fluid pressure chamber for delivering fluid pressure thereto to operate the rotor, substantially as described.

1,101,979. PNEUMATIC-VALVE MECHANISM. William A. Watson, Malden, Mass.

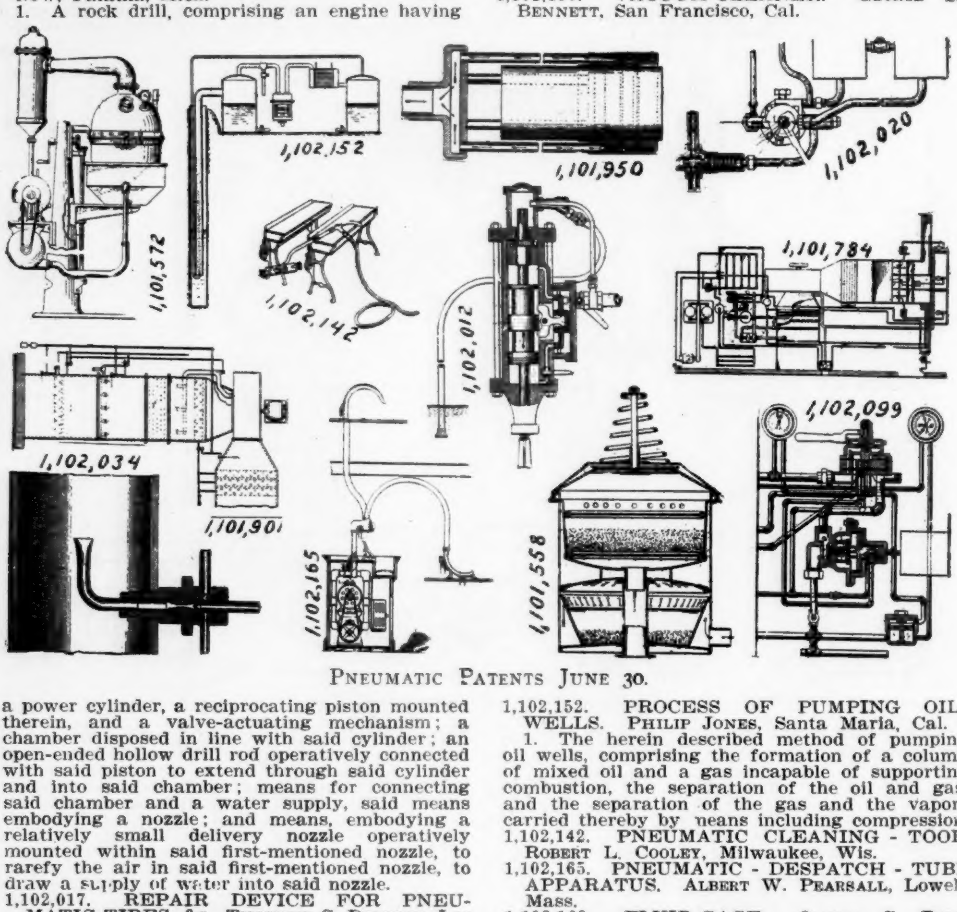
1,102,012. ROCK-DRILL. John Thomas Curnow, Palatka, Mich.

1. A rock drill, comprising an engine having

between the condenser and the exhausting means, a drainage pipe connection from the motor to the exhausting means, augmentor means having a connection to the connection between the condenser and exhausting means, said connection being made at the level to which condensed fluid is permitted to rise within the motor, a connection conveying fluid from the augmentor means to the exhausting means and means by which any uncondensed fluid which has already passed from the augmentor means to the exhausting means is prevented from circulating through the other pipe connections back to the augmentor means.

1,102,099-100. AIR-BRAKE SYSTEM. Jacob Rush Snyder, Pittsburgh, Pa.

1,102,130. VACUUM-CLEANER. George S. Bennett, San Francisco, Cal.



Pneumatic Patents June 30.

a power cylinder, a reciprocating piston mounted therein, and a valve-actuating mechanism; a chamber disposed in line with said cylinder; an open-ended hollow drill rod operatively connected with said piston to extend through said cylinder and into said chamber; means for connecting said chamber and a water supply, said means embodying a nozzle; and means, embodying a relatively small delivery nozzle operatively mounted within said first-mentioned nozzle, to rarefy the air in said first-mentioned nozzle, to draw a supply of water into said nozzle.

1,102,017. REPAIR DEVICE FOR PNEUMATIC TIRES, &c. Timothy C. Dobbins, Los Angeles, Cal.

1,102,020. DOUBLE-HEADING AIR-BRAKE SYSTEM. Frank H. Dukesmith, Meadville, Pa.

1,102,033-4. ATOMIZER. Edward Joseph Franklin, Salt Lake City, Utah.

1,102,071. CONDENSING APPARATUS. Charles Algernon Parsons, Newcastle-upon-Tyne, and Stanley Smith Cook, Wallsend, England.

1. An apparatus for obtaining a high degree of vacuum comprising in combination a motor, a condenser receiving the fluid discharged from said motor, exhausting means, a pipe connection

1,102,152. PROCESS OF PUMPING OIL-WELLS. Philip Jones, Santa Maria, Cal.

1. The herein described method of pumping oil wells, comprising the formation of a column of mixed oil and a gas incapable of supporting combustion, the separation of the oil and gas, and the separation of the gas and the vapors carried thereby by means including compression.

1,102,142. PNEUMATIC CLEANING-TOOL. Robert L. Cooley, Milwaukee, Wis.

1,102,165. PNEUMATIC-DESPATCH-TUBE APPARATUS. Albert W. Pearsall, Lowell, Mass.

1,102,168. FLUID-GAGE. Oliver C. Ritzwoller, Jacksonville, Fla.

1,102,185. PNEUMATIC-DESPATCH-TUBE APPARATUS. James T. Cowley, Boston, Mass.

1,102,204. AIR-GUN. Earl V. Shue, Milwaukee, Wis.

1,102,216. PIANO-PLAYING AIR SYSTEM. Robert A. Gally, Cincinnati, Ohio.

1,102,222. FLUID-PRESSURE APPARATUS. William G. Abbott, Jr., Milford, N. H.

1,102,225. PNEUMATIC-DESPATCH-TUBE APPARATUS. Albert W. Pearsall, Lowell, Mass.